TECHNICAL REPORT
66-22-FD

DEVELOPMENT OF A MACHINE RETRIEVAL SYSTEM FOR STORAGE DATA ON RATION ITEMS

by
Murray E. Sherry

Charles W. Adams Associates, Inc.
Bedford, Massachusetts 01730

Contract No. DA19-129-AMC-187(N)

April 1966

UNITED STATES ARMY
NATICK LABORATORIES
Natick, Massachusetts 01760

Food Division
FD-42

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FOREWORD

From its inception, Food Division has conducted storage studies of food items, both experimental items and standard ration items Data resulting from these storage studies had been invaluable in providing the direction for needed research and development and for guiding storage officers in the military services in maintaining high quality in the rations. As the data corpus has grown, it now includes data from studies extending back more than 25 years, ready accessibility has become severely limited.

Physical incorporation of Food Division into U.S. Army Natick Laboratories made available a functioning computer operation with a GE-225 computer. The desirability of placing the storage study data into the computer for ready retrieval and correlation was obvious. A preliminary coding scheme for this purpose was developed within Food Division.

This study represents a evaluation of the coding scheme, its revision to suit the GE-225 computer, and the development of an experimental program for teletypwriter input onto magnetic tape and machine retrieval and simple correlation using the GE-225 computer. The work is as performed by Charles W. Adams Associates, Inc. under Contract No. DA-19-129-AMC-187(N) (July 1963 - March 1964). The investigator was Dr. Murray E. Sherry.

The U.S. Army Natick Laboratories Project Officer was Albert S. Henick and the Alternate Project Officer was Otto G. Stark, both of Food Chemistry Branch, Food Division.

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ABSTRACT

A coding scheme for machine storage and retrieval of storage study data on ration items has been evaluated and a revised version recommended. An experimental program for a magnetic tape GE-225 computer system has been designed and written. This program can retrieve storage study data from a data corpus previously stored on magnetic tape. It can, furthermore, perform simple corretations on pairs of details, such as storage time versus experimental data, stored in the data corpus. A second experimental program that acquires the storage study data directly from typed input onto magnetic tape has been written. The output of this program, which was developed for the Keydata Corporation PDP-4 on-line data processing system, has been made compatible with the GE-225. The programs were tested by operating them with a small data corpus of experimental information.

I. INTRODUCTION

During the past few decades the collection of large quantities of experimental data has led to ever-increasing requirements for economical storage and retrieval systems. This problem has been studied by Adams Associates for the Quartermaster Research & Engineering Center, which has been collecting storage study data on rations and ration items. Included are data on processing, packaging, storage time and temperature, and chemical, physical and sensory analytical procedures.

The current experimental study of information storage and retrieval methods has been conducted in several phases. A coding scheme prepared by the QR&EC has been evaluated and a revised version recommended. An experimental program for a magnetic tape GE-225 computer system has been designed and written. This program can retrieve storage study data from a data corpus previously stored on magnetic tape. It can, furthermore, perform simple correlations on pairs of details, such as storage time versus experimental data, stored in the data corpus. Lastly, a second experimental program that acquires the storage study data directly from typed input onto magnetic tape has been written. The output

of this program, which was developed for the Keydata Corporation PDP-4 on-line data processing system, has been made compatible with the previously mentioned GE-225.

Demonstrations of these two programs were given on February 27 and March 2, 1964, and acceptance of them was expressed by the QR&EC in letters dated February 28 and March 3, 1964. This report fulfills the final requirement of the study performed under Contract No. DA19-129-AMC-187(N).

Much knowledge was gained during the writing of the aforementioned programs and operating them with the small data corpus of experimental information taken from 25 pages of storage study data. It has become clear that several modifications to the experimental system are required to achieve a highly efficient and economical production system. These details are mentioned in this report and will be further amplified in a separate proposal.

II. CODING SYSTEM

An initial set of five classes was submitted by QR&EC for study. A group of codes for class and subclass was submitted under Table 1,* in which the classes are divided into eleven discrete categories, the identifying codes running from 01 to 11, with a set of subclass codes, starting with 01, for each class. Subclass 99 has been reserved for miscellaneous subclass distributions for each class. All ration items were subsequently classified in Table 2 with a seven-character code. The first four characters are the class and subclass codes, the fifth is the first alphabetic character of the English nomenclature for the item, and the last two characters are a chronological code, starting with 01, for each item under a specific class and subclass.

The other three tables contain lists of ingredients, processing codes, and packaging codes. Whereas the classes and subclasses are limited to two numeric characters (up to 99 unique codes), the other three tables are allowed to vary from 001 to 999 (three numeric characters). The actual codes

*The codes assigned in the original tables have been reproduced in the current tables for food items and ingredients, packaging and processing. The class and subclass codes have been retained.

Tables 1 - 4 are in appendix A.

assigned to the particular items in the three tables are random, with no attempt made to correlate items in similar groupings.

The randomly assigned codes seem to have certain disadvantages. One is that it might be desirable to retrieve not only individual items but also related sets of items. If there were no inherent grouping among the items in a code set, it would be necessary to list explicitly all the items desired. For example, a food scientist might want to study all preserved food items. A single identification of a class of processes would be much more efficient than the listing of a score of three-digit numbers which bear no relation to each other. The opportunity for making errors with a single code would be much less than with a group of random numbers.

Another difficulty of dealing with random codes would be encountered when new experimental data was being acquired. New ingredients, processes or packages are likely to occur at any time with the further development of food technology. A scheme of code classes would allow the scientist entering a new item into the system to determine if the process were, say, new. All processes belonging to the same class could be listed on one page, permitting a quick scan before assigning

a new and unique code. This capability is particularly important because of the seeming lack of uniformity in the assignment of names and designations to foods and related categories.

After a study of the original tables of processes and packagings, it was decided to group the items into classes and assign chronological codes to individual items within each class. With the items as given in the original tables, no more than eighteen items have been grouped within a single class.

There seemed to be a fair amount of duplication between the items listed as ingredients and those as food items. This is not surprising since many food items, such as stews, consist of ingredients that are also food items themselves. In addition, condiments, which are stored and shipped individually and thus are classified as food items, are essential mixtures in food products. It was therefore decided to drop the unique classification of ingredients and adopt the single coding scheme of class, subclass, and chronological code for both food items and ingredients. A tag could be assigned to such a code to indicate whether it was being considered a food item or an ingredient.

Subsequent to the development of these initial tables, an itemized list of test procedures was submitted for study. These procedures were already divided into meaningful groupings, which were accepted as such. The large number of test procedure items suggested that a three-level code of class, subclass, and chronological code be assigned. The submitted four-level code was thus reduced to a three-level code.

The resultant four tables of food items or ingredients, processes, packagings, and test procedures have been itemized in Appendix A. A tentative class, subclass (where necessary), and chronological code has been assigned to each item submitted in the original six tables. The particular code assignments need not be considered as permanent but only as exemplary of the revised scheme.

In the course of coding the 25 pages of data furnished by QR&EC, it became evident that there are a number of duplications in the tables of Appendix A. The automated scheme of acquisition, described in Section V and recommended for acceptance, lends itself to the elimination of redundant and other unnecessary codes that can easily escape the notice of a scientist working with a manual system. In the automated scheme, only class and subclass designations would be manually

submitted in the assignment of a new code. A unique chronological code would then be automatically assigned if the item did not correspond to any other in the same class and, optionally, subclass. Two nomenclatures for the same item could be handled by assigning both the same chronological code.

The assigned codes in the four tables of Appendix A are not entirely consistent. Some codes start with 0 (zero) and others with 1 (one). A miscellaneous code, 99, is still used in the table of food items. These items can be made consistent when a production form of the acquisition program is adopted and code assignments are made automatically.

The size limitations of the original codes were a result of thinking oriented to card images, and thus were multiples of ten with maxima of 9, 99, 999, etc. The limitations in the recommended system are functions of binary numbers, with the new maxima being powers of two: 7, 15, 31, 63, 127, etc. Both numbering systems are open-ended, in that a new column permits ten times as many decimal codes while an extra bit in a machine word permits twice as many binary codes. No inherent distinction need be made between the two, it being merely a matter of convenience in relating the numbers to the overall system adopted for information acquisition and retrieval.

III. RETRIEVAL AND CORRELATION PROGRAM

To prove the feasibility of retrieving and correlating information on storage study data, a GE-225 program was developed. The program is designed for a machine configuration of at least 8,192 words of core storage and four magnetic tape units. This experimental program was written only to demonstrate the distinct features of retrieval and correlation, as well as the auxiliary operations of initialization and printout. Since the program was not intended for production purposes, it was designed to fit entirely into core memory.

The program was made as flexible as possible. Thus, the description of a typical item of storage study data was assigned to a short table. The type, length and location of every field of information in an item were included in the table. This provides complete flexibility in retrieving items. At the same time, any two fields can be correlated. It should be obvious that such requests can produce meaningless data since fields containing coded values of non-numeric data could be correlated.

The program has been designed to retrieve not only a single simple request (all meats, for example) but a large number of independent simple requests or a smaller number of

complex requests with many conditional statements. A retrieval request is made by stating the field of interest, one of six conditional statements ($=$, $\neq$, $>$, $<$, $\geq$, $\leq$), and a value for comparison. The statements are then linked with logical "and" and "or" statements. Hence a request can be made for all items of ham or roast beef, where the ham items are of interest only if boiled and salted. In a parenthetic expression, this could be stated as (roast beef or (ham and (boiled and salted))). The retrieval request would be made with four statements for roast beef, ham, boiled, and salted, with appropriate connectors. Specific examples are given in Section IV.

Simple correlation is performed with the submission of two statements describing the fields to be correlated, both of which must exist in each item of interest. Thus it is necessary to have previously used the retrieval option of the program to isolate these items on a separate magnetic tape. Presently no distinction is made between an empty field and one containing a zero value, so that the decision of whether or not to eliminate vacuous fields would have to be made prior to correlation.

The program has two other options in addition to retrieval and correlation. The first is initialization, which permits the entrance of a different table to describe the data to be retrieved or correlated. This option indicates the inherent independence of the program from the data. A modification of this table would permit an entirely different organization of data. The second option enables the material stored on magnetic tape to be printed on a high-speed printer. A legible non-tabular format, with descriptive comments and abbreviations, was selected for experimental use. The print option is the only special-purpose routine in the entire program and can only print the format used for the storage study data.

When a request for retrieval, correlation or printing is made, the location of the magnetic tape containing the input information is indicated. For both correlation and printing, no other tape is needed. In the former, the coefficient of correlation is printed by the on-line typewriter; in the latter, the entire contents of the tape are printed by the high-speed printer. For retrieval, however, a second tape is needed. All the items selected will be written on the second tape in the same format as they appeared on the input tape. This permits a scientist to select later a subset of the data initially retrieved.

The program and its many routines, as well as an outline of the format of both magnetic-tape data and the several tables stored in core memory are discussed below. A detailed flowchart of the program is included in Appendix B. A number of operations are performed using standard library routines provided by General Electric. These are not described in this report but are included in the program listing submitted under separate cover.

Magnetic-Tape Data

Storage study data is stored on magnetic tape in dictionary and data records. A single dictionary record, describing the food item, its ingredients, and an English commentary, is followed by as many data records as necessary. Each describes the results of a number of tests performed on an item stored for a specific time and at a specific temperature. In this manner, information that is space-consuming and constant for many data items need not be repeated. Some of the stored information is placed in fixed fields while others are assigned variable-length fields, again to reduce the space requirements.

Dictionary Record

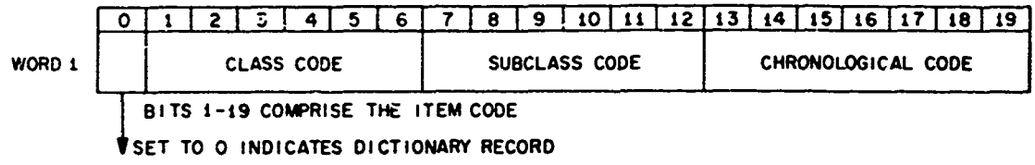
The first three words of a dictionary record contain fixed-length fields. Word 1, as shown in Figure 1, contains a 19-bit number which specifies the food item and acts as a link between itself and the data records. The number is divided into three fields: bits 1-6, class code; 7-12, subclass code; and 13-19, chronological code. The codes are taken from Table 1 in Appendix A. Except for bit 0, which is equal to zero, this word is identical to Word 1 of the data record.

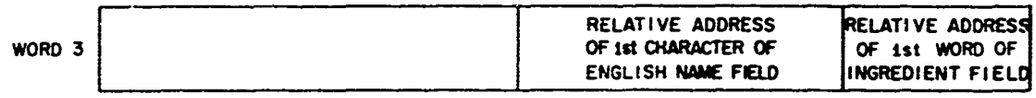
Word 2, used in controlling errors and avoiding duplication, will be either a number or a date stamp indicating when this item entered the system.

Word 3, bits 9-15, contains a relative address specifying where the first English character of the name appears in this record; and bits 16-19 contain the relative address of the first word of the ingredient variable field. All addresses in the dictionary record are relative to the first word of that record.

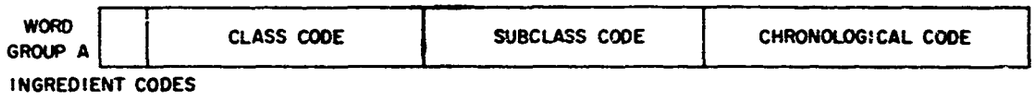
All other words of a dictionary record contain two variable-length fields. Word group A consists of a number of words representing food ingredients, each stored in a

FIXED-LENGTH FIELDS



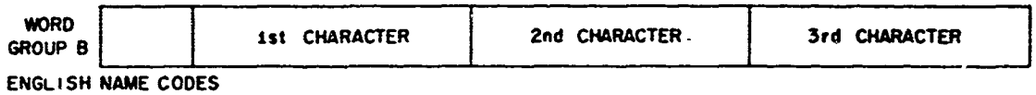


VARIABLE-LENGTH FIELDS



INGREDIENT CODES

A MAXIMUM OF 63 WORDS PER ENTRY, PERMITTING 63 SEPARATE INGREDIENTS



ENGLISH NAME CODES

A MAXIMUM OF 21 WORDS PER ENTRY, PERMITTING 63 CHARACTERS IN THE ENGLISH NAME. THE FINAL CHARACTER IS A SENTINEL CHARACTER SIGNIFYING THE END.

Figure 1

DICTIONARY RECORD FORMAT

separate word in a format similar to that of Word 1. The class, subclass, and chronological codes are also obtained from Table 1, Appendix A. A maximum of 63 ingredient words per entry is permitted.

Word group B, which immediately follows the last word of group A, contains the BCD equivalent of the English name of the item. A maximum of 21 machine words permits a 63-character title. The final character stored must be a sentinel character to signify the end of the record.

Data Record

The first nine words of a data record contain fixed-field information. Word 1, as shown in Figure 2, contains a 19-bit number which specifies the food item and identifies the data record. This word is identical to Word 1 of the dictionary record except that bit 0 equals one.

Word 2 is a number or date stamp indicating when this item entered the system. Word 3, bits 3-6, indicates whether the food sample used in the test was experimental, standard, or otherwise; bits 7-12 contain the identity of the research group which submitted the data; and bits 13-19, the year in which the data was submitted.

FIXED-LENGTH FIELDS

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
WORD 1		CLASS CODE						SUBCLASS CODE						CHRONOLOGICAL CODE						

BITS 1-19 COMPRISE THE ITEM CODE

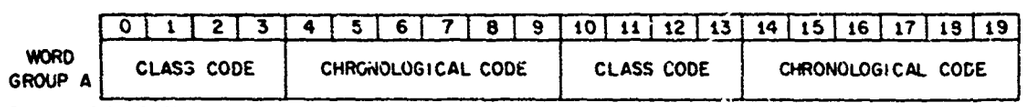
SET TO 1 INDICATES DATA RECORD

WORD 2	DATE OR NUMBER INDICATING WHEN THIS ENTRY ENTERED SYSTEM			
WORD 3		KIND OF SAMPLE	SUBMITTING ACTIVITY	YEAR OF SUBMISSION
WORD 4	±	STORED TEMPERATURE	UNIT OF TIME	NUMBER OF TIME UNITS ITEM HAS BEEN STORED
WORD 5		GM OR OZ	EVALUATING LABS SERIAL NUMBER	EVALUATING LABS EXPERIMENT NUMBER
WORD 6		UNIT SIZE IN 1/10 OUNCES OR GRAMS		
WORD 7			DATE OF PROCESSING MONTH	DATE OF PROCESSING YEAR
WORD 8			RELATIVE ADDRESS OF 1st WORD OF PROCESSING FIELD	RELATIVE ADDRESS OF 1st WORD OF PACKAGING FIELD
WORD 9		RELATIVE ADDRESS OF 1st CHARACTER OF SPECIAL REMARK FIELD	RELATIVE ADDRESS OF 1st WORD OF EVALUATION FIELD	

Figure 2

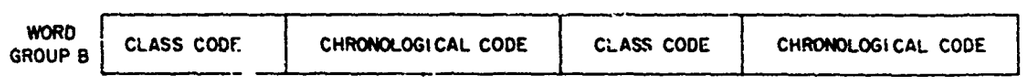
DATA RECORD FORMAT
(Part 1 of 2)

VARIABLE-LENGTH FIELDS



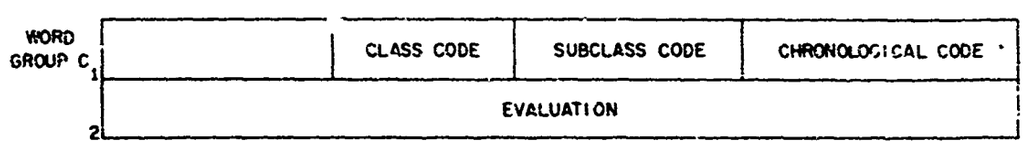
PACKAGING CODES

A MAXIMUM OF 2 WORDS PER ENTRY, PERMITTING UP TO 4 SEPARATE LEVELS



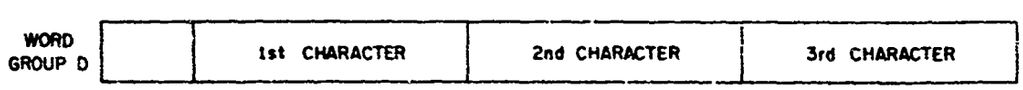
PROCESSING CODES

A MAXIMUM OF 33 WORDS PER ENTRY, PERMITTING UP TO 66 SEPARATE PROCESSES



EVALUATION CODES

A MAXIMUM OF 126 WORDS PER ENTRY, PERMITTING 63 SEPARATE EVALUATIONS.
WORD 1 OF GROUP C CONTAINS THE TEST PERFORMED; WORD 2, THE RESULT OF THE TEST.



SPECIAL REMARK CODE

A MAXIMUM OF 21 WORDS PER ENTRY, PERMITTING A REMARK FIELD OF 63 CHARACTERS.
THE FINAL CHARACTER WILL BE A SENTINEL CHARACTER SIGNIFYING THE END.

Figure 2

DATA RECORD FORMAT
(Part 2 of 2)

Word 4, bits 0-8, indicates the storage temperature, which may range from -255_{10} to $+255_{10}$ degrees Fahrenheit; bits 9-11 contain the time units (such as months) in which storage duration is expressed; and bits 12-19, the number of time units the item has been stored.

Word 5, bits 3-7, gives the serial number of the laboratory performing the evaluation; and bits 8-19 contain the reference number assigned to the experiment by the laboratory. Bit 1 of Word 5 specifies the unit of weight of the sample in grams or tenths of an ounce whereas bits 1-19 of Word 6 contain the number of weight units equivalent to the sample weight.

Word 7, bits 9-12, indicates the month in which processing was completed for the sample tested; and bits 13-19 contain the year processing was completed.

Word 8, bits 12-16 indicates the data record word in which the first processing code is stored; and bits 17-19 indicate that in which the first packaging code is stored.

Word 9, bits 4-11, indicates the data record word in which the first English character for special remarks is stored; and bits 12-19 indicate that in which the first evaluation code is stored.

The remainder of the data record words contain variable-length fields. Word group A permits two packaging codes to be stored in each of two words. Bits 0-3 contain the class of a packaging code; and bits 4-9, the chronological code. Bits 10-13 contain the class of the next packaging code; and bits 14-19, the chronological code The packaging codes are in Table 3 of Appendix A.

Word group B permits two processing codes to be stored in each word in a format identical to word group A. A maximum of 33 words may be used to contain 66 processes, the codes for which are in Table 2 of Appendix A.

Word group C allows one evaluation to be stored in two consecutive words. Bits 5-8 of the first word contain the evaluation class; bits 9-13, the evaluation subclass; and bits 14-19, the evaluation chronological code. Thus the first word of each pair specifies the test performed. The second word of the pair contains the results of the test. A total of 63 evaluations, occupying 126 machine words, may be stored.

Word group D permits 63 characters to be stored in up to 21 words. The final character stored must be a sentinel character to signify the end of the record.

Internally Stored Tables

Record Format Tables

The primary record format table (PRFT), as shown in Figure 3, consists of one-word items that are responsible for the identification, location and unpacking of the dictionary and data records. There are two types of descriptive words in the table: fixed-field and variable-field. They differ in that the former contains a zero in bit 0 and the latter a one. Sixteen bits of information are enough to find and unpack a fixed field. Stored in bits 4-9 is the record word number of the field where information is stored. Bits 10-14 indicate the extract pattern necessary to isolate this information; and bits 15-19 indicate the amount of shift required to right-justify the information.

One machine word cannot contain sufficient information to locate and unpack a variable field. Bits 1-6 contain the address of a word in the secondary record format table (SRFT) relative to the first word of that table. Bits 7-9 indicate a specific word in the variable field, since there may be more than one word in a variable-field item. Bits 10-14 specify the mask needed to isolate this information from the word in which it is packed; and bits 15-19, the amount of shift needed to right-justify the word.

PRIMARY RECORD FORMAT TABLE

FIXED-FIELD DESCRIPTOR

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0				WORD NUMBER OF RECORD						NUMBER OF BITS FOR MASK					AMOUNT OF SHIFT TO UNPACK				

VARIABLE-FIELD DESCRIPTOR

1	SRFT ADDRESS	WORD NUMBER OF VARIABLE FIELD ITEM	NUMBER OF BITS FOR MASK	AMOUNT OF SHIFT TO UNPACK

SECONDARY RECORD FORMAT TABLE
(FOR VARIABLE FIELDS ONLY)

	NUMBER OF WORDS IN VARIABLE FIELD ITEM	WORD NUMBER OF VARIABLE FIELD CONTROL WORD	NUMBER OF BITS FOR MASK	AMOUNT OF SHIFT TO UNPACK

Figure 3

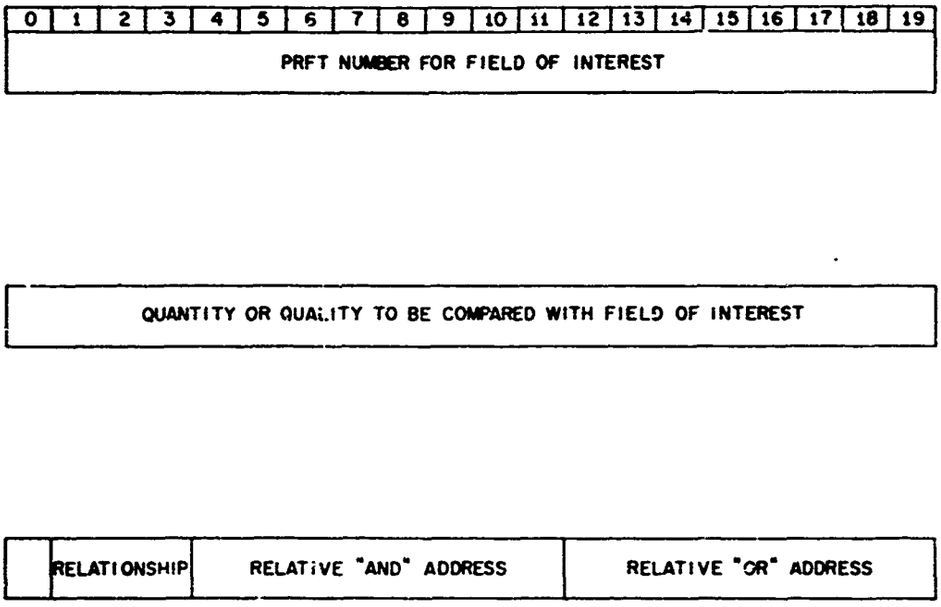
PRIMARY AND SECONDARY RECORD
FORMAT TABLE LAYOUT

The SRFT contains the location of information indicating where each variable field starts. Bits 1-3 contain the total number of words of a variable field item. Bits 4-9 contain the relative address of the variable-field control word, a fixed field in the dictionary or data record, that contains the starting address of the variable field in this record. Bits 10-14 specify the extract pattern for the control word; and bits 15-19, the amount of shift to right-justify the control word.

Query Table

The query table, addressed in the program as KTAB, contains information supplied by query cards and further amplified by the "and/or" algorithm. This table consists of three-word items, of which there may be a maximum of 84. The first word, as shown in Figure 4, contains the number of the word in the PRFT that describes the field of interest. The second word contains the actual quantity to be compared with the field specified by the first word of the three-word format.

The third word has three significant pieces of information. Bits 1-3 contain a number which establishes the desired relationship between the field and the quantity to be



RELATIONSHIPS TO BE DESCRIBED IN WORD 3 BITS 1 -3 :

RELATIONSHIP	REPRESENTED BY
=	0
≠	1
>	2
<	3
≥	4
≤	5

Figure 4

QUERY TABLE LAYOUT

compared This relationship can be: equality, inequality, greater than, less than, greater than or equal to, or less than or equal to. Bits 4-11, if not equal to zero, contain the address of another three-word item which is linked to this one by a logical "and." Similarly, bits 12-19 contain the address of another item linked by an "or." These addresses are relative to the first word of the query table and always refer to the third word of a three-word item.

Program

The program consists of four major divisions: initialization, retrieval, correlation, and printing. Except for the print routine, the routines have been designed so that they are dependent only on tables that, in turn, are altered only to modify the routines. Wherever possible, GE-225 precoded general-purpose utility routines have been used (see Appendix C). In a production system, however, many of these would be replaced by shorter and more efficient special-purpose routines.

The program driver is described first, then the initialization routine. The various routines used for retrieval are followed by those used for correlation. Lastly is a

description of the print routine. In addition to the utility routines in Appendix C, all error halts are listed in Appendix D.

Driver (DRVR)

This routine, which controls the operation of the entire program, reads an ID card that specifies both the operation to be performed (initialization, retrieval, correlation, printing) and the tape handlers, if any, to be used. It then calls to the proper routines to perform the specified operation. When the operation has been completed, the driver enters a waiting loop where it remains until Console Switch 0 is toggled. Another ID card is then read, repeating the cycle.

Control is initially transferred to the driver (location 6000_8) by a transfer card when the program is loaded; thereafter, the driver is normally entered from the waiting loop.

File Set Up (FILSET)

The initialization routine, FILSET, reads in a deck of input cards that describe the format of the dictionary and data records. The contents of these cards are placed in the

PRFT and SRFT for reference by the rest of the program. These tables need be set only once when using the program since they are never modified.

Input consists of exactly 48 cards containing an octal number ranging in value from zero to 3777777 punched in columns 20-26. The SRFT, with seven locations following location SRFT, and the PRFT, with 41 locations following location PRFT, are formed by storing the contents of these cards in sequential memory locations starting with the first word in the appropriate table. The table formats have been described previously.

In the input deck, the cards for the SRFT must precede those for the PRFT. The last card for each table must be blank, that is, only six and forty cards, respectively, can contain significant information, a condition tested for in this routine.

It is possible to alter the number of descriptors in the two format tables from the present limits. To allow m descriptors in the SRFT, location FLST2-3 should be made BXL m+1 2, FLST2+10 should be LDA SRFT+m, and m locations should be left free following location SRFT. Likewise, to allow n descriptors in the PRFT, location FLST2+8 should be

made BXL n+1 2, FLST2+13 should be LDA PRFT+n, and n locations should be left free following location PRFT.

Calling Sequence:

```
SPB FILSET   3
Return
```

The next seven routines are used in the retrieval function. The first three, CIS, FILTER, and the pushdown set, are always used before actual retrieval takes place, being responsible for reading, interpreting and processing inquiry cards. The second group of routines, RTRVL, DCID, DIRED, and DIWRI, carry out the retrieval function.

Card Input Scheme (CIS)

This routine reads and interprets a series of inquiry cards to determine the basis for retrieval. The information is stored in tabular form in the query table.

Input to CIS is a series of up to 85 inquiry cards, from each of which a three-word item in the query table is created, followed by an end card. The format for the information on the inquiry cards given below may be changed by altering the field parameter table described later in this section. All numbers punched on inquiry cards are decimal integers.

Six fields of information, the first four required and the last two optional, are placed on an inquiry card. The required fields identify the number of the card, an item of the PRFT which, in turn, identifies the selected data field of interest for retrieval; a test value to compare the data field against, and an indication of the type of test, such as "equal" or "less than", to be used in the comparison.

The last two fields, the "and" and "or" fields, link the different inquiry cards of a set. If two conditions, represented by two inquiry cards, must be met for the retrieval of an item to take place, the inquiry card of the first condition must have the number of the card of the second condition in the "and" field of the first card. Similarly, if either of two conditions is sufficient for retrieval, that number must be placed in the "or" field of the first card. In a complex retrieval request, some inquiry cards can have both the "and" and "or" fields filled, others only one of the fields filled, and still others have both fields empty.

End cards have END punched in columns 61-63. After an end card has been processed, the quantity of inquiry cards preceding it is stored in location NIT.

Within CIS, the following subroutines are used:

CISI reads the initial query card, initializes the card counter, and clears test registers used by INFLD.

INFLD converts the decimal numbers of the card fields to binary numbers and stores these into the three-machine-word query table entry. INFLD also checks that the numbers in the field do not exceed their assigned limits and that the other restrictions specified by the field parameter table are observed.

CIS converts decimal numbers from five card fields to binary values stored in three-machine-word sequences in the query table. The field parameter table controls the card location of these fields and the location in the query table entry of the binary numbers formed from them.

The card fields may be anywhere on the card except in columns 1-5 or 61-63. Columns 1-5 are reserved for the card number and columns 61-63 for END on the end card. The information in the card fields is expressed in decimal integers which may not exceed 524,287. The fields may be in any order on the card.

There are five field parameter words in the table, each word controlling one card field. The fields controlled by the first three words are compared with pre-stored constants. If the number in any field exceeds the corresponding

constant, the inquiry series is rejected. The number in the field controlled by the fourth parameter word (the "or" field) must be the same as the card number of one of the inquiry cards of the series. This restriction also applies to the field controlled by the fifth word (the "and" field); moreover, no two cards in the series may have the same number in this field.

Bits 0 and 1 of the field parameter word indicate in which of the three words of a query table entry the specified field is to be stored. 00 indicates the field is to be stored in the first word, 01 the second word, and 11 the third word.

Bits 2-6 contain the number of bit positions through which the converted right-justified field should be left-shifted before the storing.

Bits 7-19 determine the position of the field on the inquiry card. This parameter is coded as a decimal number having two two-digit sets. The left two digits indicate the column on the card in which the field starts; the right two digits, the maximum number of columns the field may occupy. For example, a field with three columns starting at column 30 is specified by the parameter 3003.

Calling Sequence:

```
SPB CIS     3
Return
```

Fill in "or" and "and" (FILTER)

After the query table has been filled with up to 85 three-word items obtained from the inquiry cards and the total number of entries stored in NIT, the program applies the "and/or" algorithm, using the pushdown routines, to place "and" or "or" connecting addresses in the blank areas. When FILTER encounters an item in the query table whose blank "and" and "or" areas cannot be filled, it determines if all items have been examined. If so, a normal exit is executed; otherwise an error is indicated. There is no calling sequence to FILTER since it was coded as an open routine.

"and/or" algorithm.

If this item has both an "and" and an "or" address not equal to zero. store the "or" address in the pushdown store and then examine the item specified by the "and" address

If this item has no "and" address but does have an "or" address not equal to zero, examine the item specified by the "or" address.

If this item has a non-zero "and" address but does not have an "or" address, determine if anything is stored in the pushdown store If so, put the topmost "or" address of the pushdown store in the "or"

address of this item, not removing it from the pushdown store. If nothing is stored, leave the current "or" statement set at zero. Then, whether or not anything is stored, examine the item specified by the "and" address.

If this item has no "and" and no "or" address, determine if anything is stored in the pushdown store. If so, put the topmost "or" address of the pushdown store in the "or" address of this item, remove the address from the pushdown store, and then examine the item specified by this "or" address. If the pushdown store is empty, leave the addresses set to zero. Then check if all items have been examined. If so, the algorithm has been successfully concluded; if not, there has been an error.

Pushdown Routines

These routines are used by FILTER to store the contents of registers A and Q in successive memory registers and retrieve these items on a last-in-first-out basis. The program has four functions: initialization, storage, non-destructive retrieval, and destructive retrieval.

The two retrieval functions always retrieve the last two items stored. In both instances the items are left in the A and Q registers by the routine. If two non-destructive retrievals are made consecutively, the same two items will appear in A and Q since the pushdown store is not changed. However, if two destructive retrievals are made, two consecutive pairs of items in the pushdown store will appear in A

and Q. Every time the destructive retrieval is called, the top pair of items in the pushdown store is destroyed after being placed in A and Q.

Calling Sequence:

Initialization

```
SPB PHDIN    3
Normal return
```

Storage

```
SPB PHDNI    3
Normal return
```

Non-destructive retrieval

```
SPB PHDNØ    3
Pool empty return
Normal return (A and Q loaded with last
  two items stored)
```

Destructive retrieval

```
SPB PHDNXØ   3
Pool empty return
Normal return (A and Q loaded with last
  two items stored)
```

Retrieval (RETRVL)

This routine processes a file of data records and copies onto another tape all records that satisfy the relationships in the query table. Both the input and output files are in the same format to allow more detailed subsequent retrieval on successively smaller files.

A retrieval cycle starts when the routine examines the first word of the first three-word query table item and chooses the appropriate PRFT word. With the information stored in the PRFT word, the program unpacks the field of interest from the input record and compares it with the value stored in the second word of the query table item. One of four paths is followed. If the comparison corresponds to the designated relationship, the third word of the query table item is examined for an "and" address. If there is none, this input item is retrieved, that is, written on the output tape. A new input item is then read and the program repeats the cycle. If there is an "and" address, the testing procedure is repeated using the query table item with that relative address.

If the comparison does not correspond to the relationship, the third word is examined for an "or" address. If there is no "or" address, the item is not retrieved; a new input item is read and the program repeats the cycle. If there is an "or" address, the testing procedure is repeated using the query table item with that relative address.

The routine continues processing until the end-of-file sentinel is reached, whereupon all tapes are rewound.

RETRVL uses DIRED and DIWRI for reading and writing tapes, and DCID to determine if the designated relationship was fulfilled.

Relation Test Routine (DCID)

This routine determines whether a specified relation exists between the two quantities located in the query table item and INPC1. The conditions which may be tested are equality, inequality, greater than, less than, greater than or equal, and less than or equal. Before calling to DCID, INPC1 must be loaded with the data field to be tested. The compare and branch instruction, CAB, is used in this routine.

Calling Sequence

```
SPB DCID     3
Pass return
Fail return
```

Read Routine (DIRED)

This routine reads from tape either a data item, or a dictionary item followed by a data item. One record is normally read from tape into a fixed input area. If it is a data record, the sign of DITEST is made negative and control is returned to the calling routine. If it is a dictionary record, it is moved out of the input area, a second

read is executed, and the sign of DITES1 is made positive. If the second record is also a dictionary record, the computer halts, indicating an error. If, when attempting to read a record, an end-of-file mark is read, a separate end-of-file return is made to the calling routine.

To determine whether a record is a dictionary item or a data item, the sign of its first word is examined. A plus sign indicates a dictionary item; a minus sign, a data item. The address of the first word of the current dictionary item will be in location DIRESA, and the last word of all dictionary items will be at PRBT1-1. The first word of all data items will be at PRBT1 while location DIRES will contain the length of the data item minus 228.

The tape controller must be on plug number 1 while the input tape handler is specified by the most recent ID card read by the driver. A console typewriter and a tape controller with a dual tape handler are required.

Calling Sequence:

```
SPB  DIRED   3
End-of-file return
Normal return
```

Write Routine (DIWRI)

This routine writes dictionary and data items onto magnetic tape. Depending on the status of DITEST+1, the routine writes either a data item alone as a single record or a dictionary item followed by a data item as two separate records. When requested, it also writes end-of-file marks.

The tape controller is on plug number 1. The output tape handler is specified by the most recent ID card read by the driver. A console typewriter and a tape controller with a dual tape handler are required.

Calling Sequence:

Write record

```
SPB DIWRI    3
Return
```

Write end-of-file

```
SPB DIWRIX   3
Return
```

The next three routines, CORSET, CRLN, and RETRC, perform the correlation function.

Correlation Set Up (CORSET)

This routine reads two cards on which parameters specifying the fields to be correlated are punched. These para-

meters are converted to binary numbers and stored as two four-word tables, x-table and y-table.

There are two types of correlation: direct and indirect. In the former, values in the field specified by the input card are correlated. In the latter, values in the second field specified by the input card are correlated only if the corresponding value in the first field matches the value placed on the input card. The indirect correlation is presently used only when correlating the results of a test. The test field is specified first on the card, followed by the code of the test of interest, thence by the test result field.

A direct correlation card has a zero in column 1 and the table number of the desired field in columns 11 and 12. An indirect correlation card has, in addition to a one in column 1 and the table number in columns 11-12, a value in columns 22-27 and a second table number in columns 36 and 37.

If the correlation field is direct, the x- or y-table built from it will have zero in its first word; otherwise there will be a one in the first word. In either case, the first table number will appear, converted to a binary number, in the second word of the table. If the correlation field

is indirect, the value will appear as a binary number in the third word and the second table number as a binary number in the fourth word. If the correlation field is direct, zeros will appear in the third and fourth words.

CORSET calls to two subroutines: CISI, which is used to read one card; and INFLD, which converts numbers on the card into three binary machine words. These two subroutines are more fully described above under CIS.

Calling Sequence:

```
SPB CORSET   3
Return
```

Correlation Routine (CRLN)

This routine determines the degree of association which exists between a finite string of x and y value pairs by evaluating the expression:

$$r = \frac{N\Sigma xy - \Sigma x\Sigma y}{\sqrt{[N\Sigma x^2 - (\Sigma x)^2]\ [N\Sigma y^2 - (\Sigma y)^2]}} \quad , \quad |r| \leq 1$$

where r is the coefficient of correlation. After obtaining a value for r, CRLN prints this value in fixed decimal format on the console typewriter.

Calling Sequence

```
SPB CRLN    3
Return
```

Retrieval for Correlation (RETRC)

This routine is quite similar in structure and coding to RETRVL. The main difference is that RETRC does not use the query table or write out selected input records. Instead, it uses the x- and y-tables in place of the query table for control.

RETRC first reads a new record, then examines the first word in the x-table containing the number of the PRFT word to unpack the field. The field is then unpacked and, depending on whether it is a direct or an indirect correlation, placed into the x-table or compared with word x. If a direct correlation, the routine searches for the y-values as it did for the x-values. Once the y-values have been found, control returns to CRLN, where summing takes place. This process continues until the end-of-file mark is sensed, at which time the correlation coefficient is calculated. If it is an indirect correlation, the value extracted from the input field is compared with the word stored in the third word of the x-table. If they are equal, the format table word specified by the fourth word of the x-table is

used to obtain the PRFT word to unpack the input field to be correlated. This new field is stored in the x-table and processing continues as above.

There are no differences between the processing of x- and y-words. The x-values are taken first, followed by the y-values, each being controlled by its individual card.

Calling Sequence:

```
SPB RETRC     3
Return
```

Print Routine (PRNC)

This routine prints the contents of a file of dictionary and data records on the high-speed printer. Identifying comments and abbreviations are liberally used on the print. Ingredients, processes and test results are printed in a columnar format since more than one row of information might be required for the complete set. An end-of-file mark is used to sense the end of the routine. The print routine has been designed so that each type of print line is controlled by a separate subroutine. These subroutines are called sequentially to process a dictionary or data record.

Calling Sequence:

```
SPB PRNC      3
Return
```

IV. OPERATING INSTRUCTIONS FOR THE RETRIEVAL AND CORRELATION PROGRAM

The operation of the retrieval and correlation program is controlled by punched cards divided into five categories. First are the function cards which cause the program to choose one of four functions: initialization, retrieval, correlation, or print. Secondly there are the inquiry cards, which cause the retrieval function to prepare the logical arguments for selecting records. The third type of card, an end card, is used to terminate a series of inquiry cards. A fourth class, parameter cards, causes the correlation function to prepare the logic for correlating two fields. Finally, the format table cards describe the format of the records stored on magnetic tape.

Card Formats

Function Cards

Columns 1-10 contain the name of the function, starting in column 1. One of four words may appear: INITIALIZE, RETRIEVE, CORRELATE, or PRINT.

Column 20 contains the letter T if an input tape is to be used with this function.

Column 21 contains the tape handler number of the input tape.

Column 26 contains the letter T if an output tape is to be used with this function.

Column 27 contains the tape handler number of the output tape.

Inquiry Cards

Used only in the retrieval function, there may be any number of inquiry cards up to 85.

Columns 1-5 contain the card number, which must run sequentially.

Columns 11-12 contain a table number specifying the desired characteristic. For current purposes, this number must be taken from PRFT Numbers for Inquiry and Correlation Cards (Appendix E).

Columns 22-27 contain a value with which the desired quality or quantity can be compared. If a code, the value can be obtained from a table in Appendix A.

Column 36 describes the comparison relationship, expressed as a digit: 0 for =, 1 for ≠, 2 for >, 3 for <, 4 for ≥, and 5 for ≤.

All the columns listed above must be used on every inquiry card, while those below are used only when connectives (more than one card) are used:

Columns 41-45 may contain the card number of another inquiry card. This will be an "and" connector to the other card.

Columns 51-55 may contain the card number of another inquiry card. This will be an "or" connector to the other card.

Only a single "and" connector and a single "or" connector are allowed on an inquiry card. A compound inquiry is made with a series of such cards. For example, the logical expression "ham with salt and pepper, roast beef, or salami" can be expressed in the following sequential statement with five equivalent cards:

1.	Ham	"and" 2	"or" 4
2.	Salt	"and" 3	
3.	Pepper		
4.	Roast beef		"or" 5
5.	Salami		

End Card

This card is used only in the retrieval function and is the last card in a retrieval deck. Columns 61-63 contain the word END.

Parameter Cards

These cards, of which there must be two, are used only for correlation. There are two types: Type 0 is used for direct correlation of everything found in a fixed-length field; Type 1 is used for indirect correlation, which occurs only with multiword variable-length fields. In the latter case, a descriptor as well as a value is stored in adjacent words. To permit correlation of a specific type of item, the Type 1 card allows for the description of the item. Presently only used to correlate an evaluation, the table number for tests would first be given, followed by a value for a particular test (such as hedonic). Then would follow the table number of the field where the test value is stored; hence, if the test desired was the fifth in the stored sequence, the fifth evaluation would be correlated.

In Type 0 parameter cards, column 1 contains a 0, and columns 11-12 contain the PRFT number (taken from Appendix E) of the item to be correlated.

In Type 1 parameter cards:

Column 1 contains a 1.

Columns 11-12 contain the PRFT number of the item descriptor (taken from Appendix E).

Columns 22-27 contain the value of the item descriptor. This value is obtained from Appendix A.

Columns 36-37 contain the PRFT number of the field on which the actual correlation is to be performed.

Format Table Cards

For the system as designed, the 48 cards listed in Appendix F must be used. Columns 20-26 contain the octal format description The two tables, PRFT and SRFT, have been described in Section III.

Optional Code Conversion

In the present experimental version of the program, the individual class codes, subclass codes, and chronological codes are entered individually in decimal format, one per inquiry card. An item consisting of a combination of these codes, such as a food item with a class, subclass and chronological code, can be precoded if insertion on one inquiry card is desired.

Four composite tables can presently be condensed into single tables in the present system: food item or ingredient codes, packaging codes, processing codes, and test procedure codes. To find the composite code number for any of these codes, it is necessary to consider the bit structures of the composite code and determine the octal equivalent of the individual adjoining parts, calculating the decimal equivalent of the octal number. This number can then be entered on an inquiry card.

To find, for example, the code number which would define "component of a ration," Table 3 of Appendix A would be referenced and the following codes extracted: 07, the class code for packages; and 02, the subclass which indicates component of a ration. The resulting number, 07/02, would then be converted to an input code using the bit structure 4-6. To do so, each of the individual codes is first converted to a sum of powers of two; thus, as shown below, 07 becomes $2^2 + 2^1 + 2^0$, and 02 becomes 2^1.

	Four bits				Six bits					
19-10	9	18	17	16	5	4	3	2	11	0

The input code may then be calculated by combining the indicated powers of two: $2^8 + 2^7 + 2^6 + 2^1 = 256 + 128 + 64 + 2 = 450$, the desired input code number.

This same code number, 07/02, could also be defined on two separate inquiry cards by stating the class code as 07 on the first of two cards. This card would be connected to the second card, which would contain the subclass number 02, by an "and" connector (See Figure 5.)

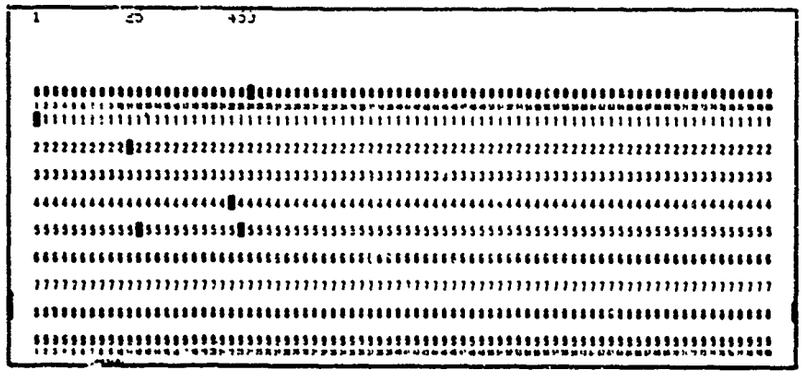
The composite codes for a number of items in the four tables have been prepared and are summarized in Appendix G. All the items coded in the 23 pages of test material are among those listed in the appendix.

Preparation of the Deck

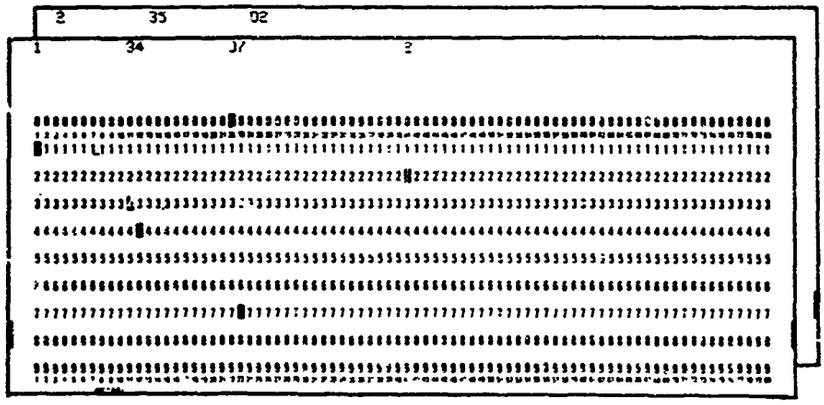
In preparing decks for the computer, the user has the option of running similar or dissimilar functions either consecutively or individually. This is determined by the way the deck is prepared; if many functions are included with the program deck, all will be processed by successive manipulations of Console Switch 0. However, only a single function need be with the program deck; when the computer pauses, more functions may be added. The function decks are made up as follows (see Figure 6):

Initialization function deck (49 cards):

1 function card
48 format table cards



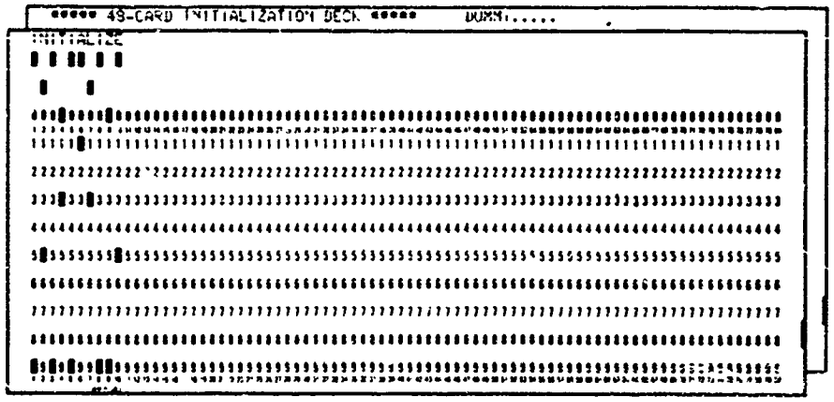
Single Inquiry Card
for Process 07/02 Component of a Ration



Multi Inquiry Card
for Process 07/02 Component of a Ration

Figure 5

OPTIONAL CODING OF INQUIRY CARDS



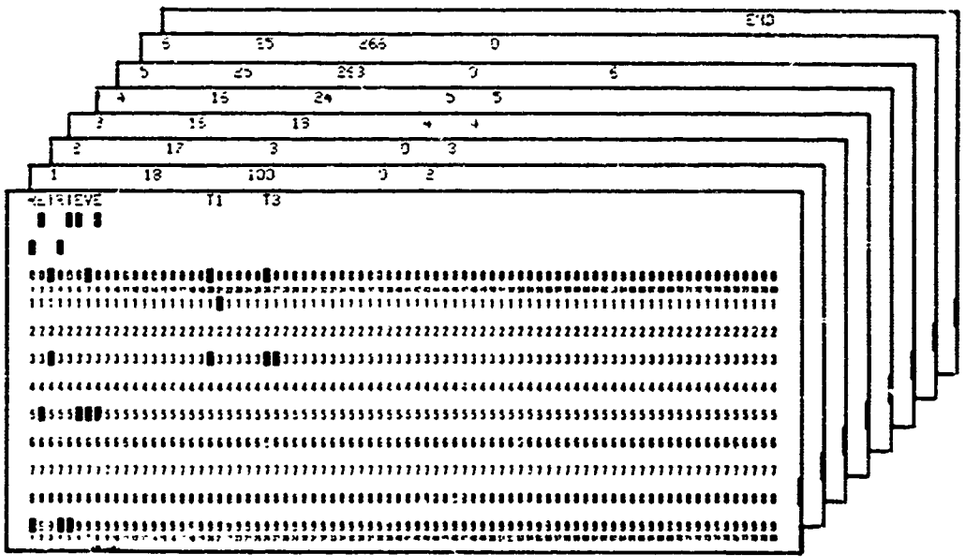


Figure 6

SAMPLE INPUT DECKS
(Part 1 of 2)
Initialize and Retrieve

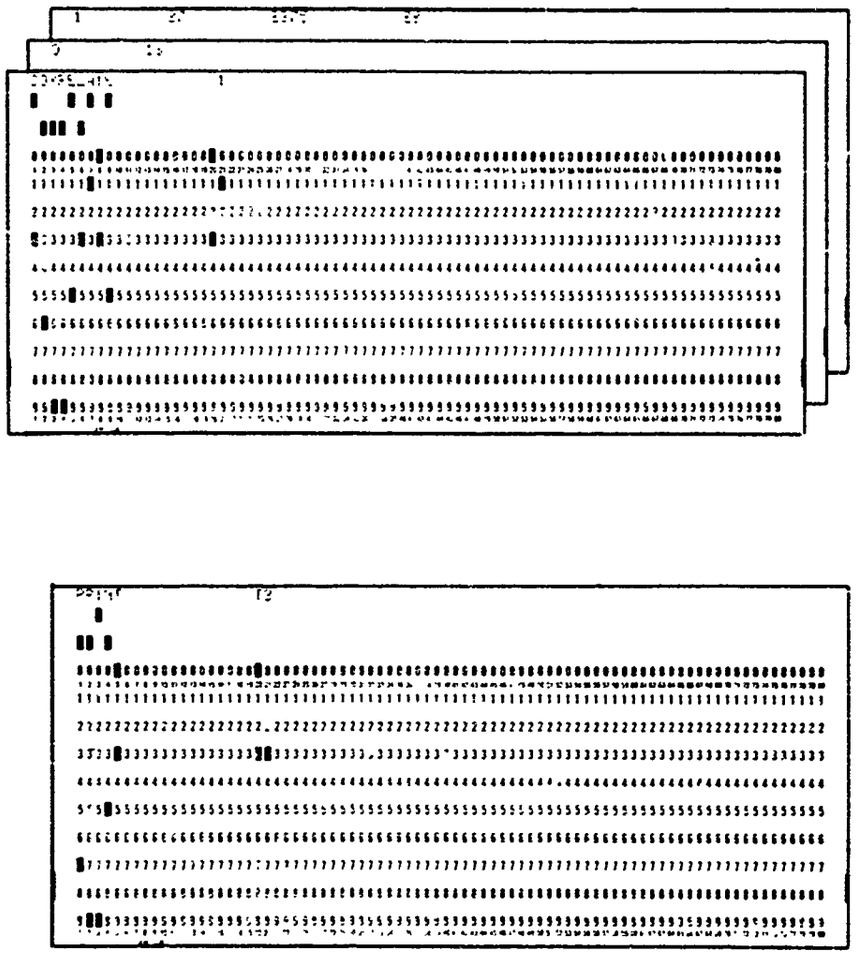


Figure 6

SAMPLE INPUT DECKS
(Part 2 of 2)
Correlate and Print

Retrieval function deck (3 to 87 cards):

1 function card
1-85 inquiry cards
1 end card

Correlation function deck (3 cards):

1 function card
2 parameter cards

Print function deck (1 card):

1 function card

After the function decks have been punched and assembled as indicated above, the running deck (see Figure 7) is assembled as follows:

Card 1 - Memory clear card

Card 2 - Memory load card

Deck of the retrieval and correlation program

Transfer card

Function decks, each followed by two blank cards and the last of the run by three blank cards.

Computer Operation

After the deck has been prepared as indicated above, the following steps are taken to run the system:

1. Mount appropriate magnetic tapes on the tape handlers.

2. Insert plug 1 in the tape logic bay.

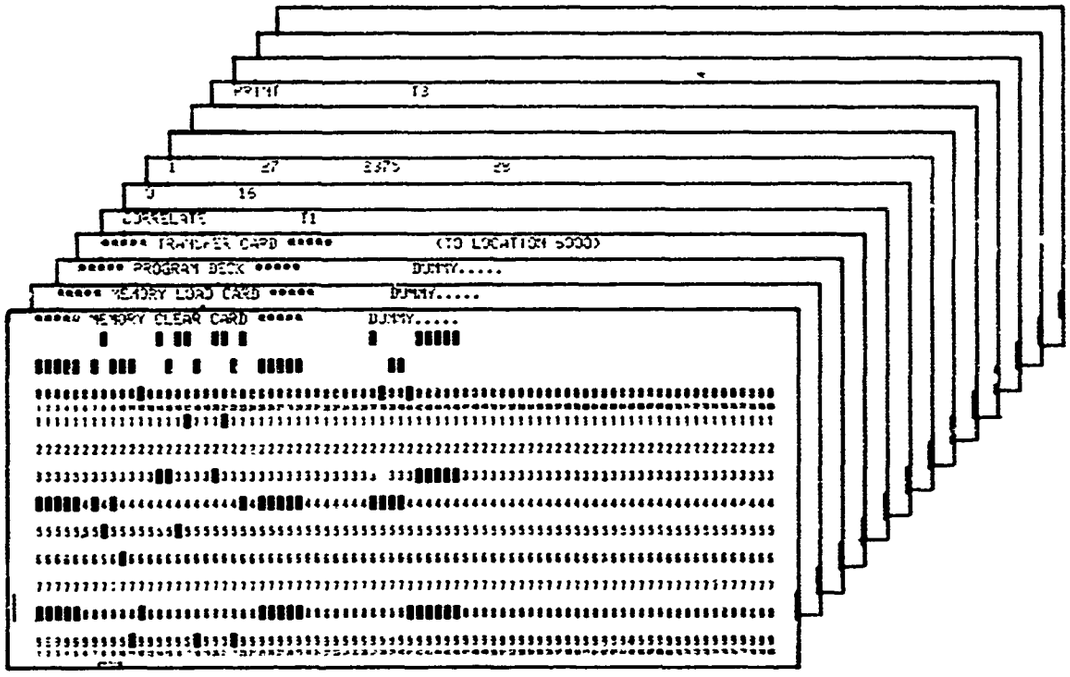


Figure 7

SAMPLE RUNNING DECK

3. Place the deck in read hopper 1.

4. Depress the MANUAL switch.

5. Depress, in order, the RESET ALARM, LOAD CARD, and RESET P buttons.

6. Repeat step 5.

7. Depress the AUTOMATIC switch, then the START button.

The program will process the first function deck and perform that function. Then it will go into a waiting loop as indicated by the number 6107 or 6117 displayed on the P-counter register lights of the console. To continue processing, Console Switch 0 must be toggled and the program will go to the next function.

If it becomes desirable to continue operation after having finished a complete run, the following steps must be taken:

1. Remove the blank card from read hopper 1.

2. Place a new function deck in read hopper 1.

3. Toggle Console Switch 0.

To restart the program (for example, after a hardware malfunction), the following steps must be taken:

1. Place the function deck in read hopper 1.

2. Depress the MANUAL switch.

3. Depress, in order, the RESET ALARM, LOAD CARD, and RESET P buttons.

4. Reset A to zeros and place instruction 2606006 into A with toggle switches.

5. Depress, in order, the A→I and START buttons. This will display the number 6006 in the P-counter.

6. If that number is not in the counter, repeat steps 4 and 5.

7. Depress the AUTOMATIC switch, then the START button.

V. DATA ACQUISITION PROGRAM

While developing the retrieval and correlation program, it became clear that the acquisition of a data corpus to demonstrate retrieval would be a tedious operation. Although the information could be prepared from punched cards for the demonstration, this would be extremely inefficient on a large scale.

The main difficulty encountered was the need for entering much more than eighty columns of information per data record. Experience with punched cards indicates that the cost of a large-scale operation with multiple cards per item grows substantially as the number of cards per record increases. Variable-length information compounds the difficulties.

The problems in planning the demonstration suggested that an attempt should be made to acquire sample data by bypassing the punched card and, instead, transmitting data directly from a typed input to a magnetic tape format. With an interpretive language for data acquisition already written for the Keydata PDP-4 computer, an acquisition demonstration was provided with only the development of an interpretive program that would allow for the man-machine interaction necessary to control the many varying fields necessary for acquisition.

In this mode of acquisition, the computer program includes a list of data to be received, the order in which it is to be accepted, and a breakdown by lines of information per record. Abbreviations of the expected data are printed by a Keydata teletype station for its operator, who then enters the information in a readable format. Data not requiring reformatting, such as temperature and storage time, can be stored directly on a PDP-4 Microtape. Food items, processes, packagings and test procedures are entered in their original nomenclature. The computer then looks up these names on a Microtape dictionary. Those that can be identified have their codes printed out at the Keydata station; the codes are then entered into the data record. Names that cannot be found, because they are either new or in error, are listed as "not in file." The operator then may reject the line or may force it through the entry by manually inserting the proper code.

Another feature is the ability to remember in entirety the last data item encountered. Since different data records from one page of experimental data are usually very similar (same time of storage, temperature, or even types of tests), the program can be flagged to repeat the constant information from the last record, adding only that information that has changed. With this scheme the margin for error is greatly decreased over the traditional approach of punched cards or punched paper tape.

A number of automatic checks have been included in the acquisition program to demonstrate the ability to control input. The simple control of forcing the Keydata operator to repeat the entire record after initially entering it would be tantamount to ordinary verification. In the present system, dates are checked to see that the month number does not exceed 12, the year is between 1900 and 1964, no number is greater than the field into which it must be placed, etc. Another sophisticated check prevents the entry of, say, a legitimate food item when a process is requested.

The output of the acquisition program is a DEC Microtape, which is not compatible with the GE-225 computer. A second program to reformat the data on Microtape in the form specified in Section III has been written. The output is placed on industry-compatible magnetic tape in binary format compatible with the GE-225.

In summary, this approach to the acquisition problem permits an operator to prepare magnetic tape records directly from the source document with all class, subclass and chronological codes automatically assigned. This eliminates the need for preparing code sheets, card punching, card verification, sequence checking of cards, card handling, and card-to-magnetic tape editing and processing. In addition, because

of the random access capability of the Microtape system and the fact that the tape number and record number for each record written is typed at the completion of each record, records can be easily modified or changed without going through the process of punching change cards, putting them on magnetic tape, and conducting a merge update. (It is estimated that this approach will result in a reduction of between 50 and 75 percent in the cost of a conventional coding and punched card system.)

The operating procedures for a Keydata teletype station are given on the next three pages.

QR&EC KEYDATA STATION PROCEDURES

Normal Procedures

Computer Item Typeout	KDS Type-in
0-	Name of item. Colon ends field. Computer types class, subclass and chronological code.
1-INGR: 6-PACK: 7-PROC: 8-EVAL:	Name of item. Colon ends field. Operator types colon as first character if field is not used. Computer types NONE and goes to next field. After computer types class, subclass and chronological code, operator types carriage return to enter another item of same field or line feed to go to next field.
3-KIND:	Up to two digits. Space ends field.
ACTV:	Up to two digits. Space ends field.
YEAR:	Two digits. Carriage return ends field.
4-TEMP:	+ or -, then up to three digits of temperature. Space ends field.
UNIT:	H, D, W, M or Y (hours, days, weeks, months, years)
TIME:	Up to three digits. Carriage return ends field.
5-SERL:	Up to two digits. Space ends field.
EXP:	Up to four digits. Space ends field.
SIZE:	Z (ounces) or G (grams), then up to six digits. Space ends field.
MO:	Up to two digits. Space ends field.
YR:	Two digits. Carriage return ends field.
2-N: 9-N:	Up to 69 alphanumeric characters. Carriage return ends field.
REC:	Operator types space. Computer writes next record on tape and responds with record number. Operator types record number, ending with space (equal to or less than last record). Computer rewrites that record on tape.
LINE:	Operator types line number at which to begin record (0-9). Computer types dotted line and line number requested. If operator has typed space, computer starts at line 3 (KIND).

Correction Procedures

Type-in	Computer Response
!N	Where N is number of characters (1-9) to be deleted. Computer retypes line, deleting number of characters indicated.
!-	Computer returns to beginning of field operator is presently working on. Note that when working on variable field, return is to start of complete field and not individual item.
!$	Computer types carriage return and line feed. Operator then types desired line number and computer returns to that line (which must be equal to or less than present line).

Record Format

0-English name: CL:XX SC:XX SCL:XX↑↓Δ

1-INGR:English name: CL:XX SC:XX SCL:XX↓Δ
English name: CL:XX SC:XX SCL:XX↑

2-N:Remarks↑↓
REC:Δ or N

3-KIND:XX ACTV:XX YEAR:XXΔ↑↓
4-TEMP:- XXX UNIT:H,D,W,M or Y TIME:XXXΔ↑↓
5-SERL:XX EXP:XXXX SIZE:Z or G XXXXXX MO:XX YR:XXΔ↑↓

6-PACK:English name: CL:XX SC:XX↓Δ
English name: CL:XX SC:XX↑

7-PROC:English name: CL:XX SC:XX↓Δ
English name: CL:XX SC:XX↑

8-EVAL:English name: CL:XX SC:XX SCL:XX READ:XX↓Δ
English name: CL:XX SC:XX SCL:XX READ:XX↑

9-N:Remarks↑↓
REC:Δ or N

LINE:Δ↓↑or N

Note: Underlined information is typed by computer. See next page for other explanations and abbreviations.

Δ = space ↑ = line feed ↵ = carriage return

Multiple symbols (Δ↑↵) mean that any of them can be used.

When finishing a variable line, a Δ or ↑ will permit the inclusing of another item, whereas a ↵ will indicate the end of the field.

REC:Δ↵↑ Computer writes this record and goes to next new record.

REC:XX Computer writes this record and resets to correct specified record.

Abbreviations

CL	Class code
SC	Subclass code
SCL	Chronological code
INGR	Ingredient codes
N	English name or special remarks field
REC	Microtape record number
KIND	Kind of sample
ACTV	Submitting activity
YEAR	Year of submission
TEMP	Degrees stored at
UNIT	Unit of time stored
TIME	Number of time units item has been stored
SERL	Evaluating lab's serial number
EXP	Evaluating lab's experiment number
SIZE	Unit size in grams or tenths of ounces
MO	Processing month
YR	Processing year
PACK	Packaging codes
PROC	Processing codes
EVAL	Evaluation codes
READ	Reading, results of the test performed
LINE	Computer line number at which to start next record

VI. PROGRAM DEMONSTRATIONS

The capabilities of the retrieval and correlation program were demonstrated on February 27, 1964, to Dr. Oesterling and Messrs. Henick, Lawlor and Stark of QR&EC; and those of the acquisition program on March 2, 1964, to Dr. Brockman and Messrs. Henick, Lawlor and Stark.

The QR&EC had previously submitted 25 pages of data to be used as test material for the demonstrations. The first 23 of these were prepared at Keydata Corporation, using the program described in Section V of this report. When all the data had been acquired, the information, stored on Microtape at that time, was converted to GE-225 binary format and written on a low-density industry-compatible magnetic tape. This tape was used as input to the test runs for verifying the retrieval and correlation program.

In Appendix H will be found considerable material pertaining to the two demonstrations. This includes a list of the 23 pages of test data used, Keydata teletype and computer printouts, and QR&EC retrieval and correlation requests.

Appendix A

CODING SCHEME FOR FOOD ITEMS

Table 1 - Food Item or Ingredient Codes 64

Table 2 - Processing Codes 7

Table 3 - Packaging Codes

Table 4 - Test Procedure Codes

Table 1

FOOD ITEM OR INGREDIENT CODES

Class/ Subclass	Description	Number of Items
Class 1	Beverages and Beverage Bases	
1/1	Cocoa and chocolate	3
1/2	Coffee	
1/3	Fruit juices	10
1/4	Imitation beverage bases	
1/5	Natural beverage bases	
1/6	Synthetic beverage bases	
1/7	Tea	
1/8	Vegetable juices	
1/9	Water	
1/99	Others	3
Class 2	Bakery, Cereals and Related Products	
2/1	Mixes, flours, meals and other farinaceous material	17
2/2	Baked, cooked and prepared cereal products	16
2/3	Cereal products with meat	
2/4	Leavening agents	5
2/99	Others	3
Class 3	Condiments and Related Products	
3/1	Salt and spices	9
3/2	Sauces	7
3/3	Flavors	11
3/4	Coloring	6
3/5	Relishes	4
3/6	Vinegar	
3/99	Others	5
Class 4	Confectionery, Chocolate and Sugar	
4/1	Candy	3
4/2	Chewing gum	
4/3	Sweet chocolate	
4/4	Cooking chocolate	
4/5	Syrups	9
4/6	Sugar	2
4/99	Others	4

Class/ Subclass	Description	Number of Items
Class 5	Dairy Foods and Eggs	
5/1	Butter	
5/2	Cheese	9
5/3	Cream	
5/4	Eggs	
5/5	Ice Cream	
5/6	Milk	5
5/7	Sherbert	
5/99	Others	3
Class 6	Fats and Oils	
6/1	Cooking fats and oils	10
6/2	Salad oil	
6/3	Spreads	3
6/4	Salad dressing	
6/99	Others	2
Class 7	Fruits	
7/1	Berries	7
7/2	Citrus	5
7/3	Jams, jellies and preserves	6
7/4	Nuts and nut products	4
7/5	Tree and vine fruits	19
7/99	Others	4
Class 8	Meats and meat products	
8/1	Beef	9
8/2	Fish	4
8/3	Meat and cereal products	4
8/4	Meat products (sausage, etc.)	21
8/5	Meat and vegetable products	12
8/6	Pork	9
8/7	Poultry	7
8/8	Shell fish	5
8/9	Veal	
8/10	Lamb	
8/99	Others	4
Class 9	Vegetables	
9/1	Leaf and stem vegetables	16
9/2	Flower, fruit and seed vegetables	21
9/3	Roots and tubers	10
9/4	Soups and bouillons	4
9/5	Vegetables with meat	2
9/99	Others	8

Class/ Subclass	Description	Number of Items
Class 10	Special Food Items	
10/1	Baby foods	
10/2	Dietetic foods	
10/3	Gelatin	
10/99	Others	28
Class 11	Composite Food Packages	
11/1	Meal, combat, individual	
11/2	Meal, landing force	

Class/ Subclass/ Chronological Code	Item	Former QR&EC Code Number
1/1/0	Cocoa	064
1/1/1	Cocoa beverage powder	296
1/1/2	Chocolate liquor	346
1/2/0	Coffee	066
1/3/0	Apple juice	004
1/3/1	Apricot nectar	007
1/3/2	Grape juice	109
1/3/3	Grapefruit juice	110
1/3/4	Grapefruit and orange juice	111
1/3/5	Lemon juice	135
1/3/6	Lime juice	139
1/3/7	Orange juice	175
1/3/8	Tomato juice	254
1/3/9	Orange juice	325
1/4/0	Beverage bases	026
1/5/0	Beverage bases	026
1/6/0	Beverage bases	026
1/7/0	Tea	253
1/9/0	Water	270
1/99/0	Ginger ale	107
1/99/1	Lemonade	136
1/99/2	Beverage packet, meal, combat, individual	377
2/1/0	Barley, pearl	015
2/1/1	Cereal, premixed, compressed	045
2/1/2	Cereals, wheat, uncooked	047
2/1/3	Corn meal	070
2/1/4	Corn starch, edible	071
2/1/5	Flour, graham	099
2/1/6	Flour, rye	100
2/1/7	Flour, wheat	101
2/1/8	Grains	108
2/1/9	Hominy, whole	123
2/1/10	Oats, rolled	167
2/1/11	Rice, brown	210

Class/ Subclass/ Chronological Code	Item	Former QR&C Code Number
2/1/12	Rice, milled	211
2/1/13	Soy flour	239
2/1/14	Tapioca	252
2/1/15	Wheat base	271
2/1/16	Corn starch	335
2/2/0	Biscuits	027
2/2/1	Bread	032
2/2/2	Cake	038
2/2/3	Cereals, breakfast, prepared	046
2/2/4	Cookies	067
2/2/5	Crackers	073
2/2/6	Macaroni	144
2/2/7	Noodles	165
2/2/8	Pound cake	201
2/2/9	Spaghetti	242
2/2/10	Vermicelli	274
2/2/11	Cookie, oatmeal chocolate chip	297
2/2/12	Cookie, sandwich	298
2/2/13	Fruitcake, bar	299
2/2/14	Fruitcake, canned	300
2/2/15	Pecan cake roll	310
2/3/0	Spaghetti with meat balls, canned	314
2/4/0	Baking soda	013
2/4/1	Powder, baking	203
2/4/2	Yeast	273
2/4/3	Calcium phosphate	328
2/4/4	Cream of tarter	336
2/99/0	Corn grits (hominy)	059
2/99/1	Dessert powders starch	082
2/99/2	Topping dessert and bakery products	259
3/1/0	Celery salt	044
3/1/1	Chili powder seasoning	059
3/1/2	Curry powder	079
3/1/3	Garlic	106
3/1/4	Onion salt	174
3/1/5	Poultry seasoning	202
3/1/6	Salt, evaporated	216

Class/ Subclass/ Chronological Code	Item	Former QR&EC Code Number
3/1/7	Spices	241
3/1/8	White pepper	374
3/2/0	Apple sauce	006
3/2/1	Catsup	041
3/2/2	Hot sauce	127
3/2/3	Meat sauce	154
3/2/4	Sauce, chili	218
3/2/5	Soy sauce	238
3/2/6	Worcestershire sauce	272
3/3/0	Extract, flavoring	090
3/3/1	Flavors	095
3/3/2	Flavoring, ice cream	096
3/3/3	Flavoring, maple	097
3/3/4	Flavoring, vanilla	098
3/3/5	Spice flavorings	240
3/3/6	Orange oil	341
3/3/7	Lemon oil	342
3/3/8	Lime oil	343
3/3/9	Imitation wild cherry flavor	342
3/3/10	Vanilla	350
3/4/0	Coloring, beverage	321
3/4/1	Orange color	337
3/4/2	Yellow color	338
3/4/3	Green color	339
3/4/4	Red color	340
3/4/5	Annotte color, cheese	354
3/5/0	Horseradish	126
3/5/1	Mustard, prepared	164
3/5/2	Pimentos	190
3/5/3	Sauerkraut	219
3/6/0	Vinegar	257
3/99/0	Monosodium glutamate	162
3/99/1	Pickles	188
3/99/2	Citric acid	322
3/99/3	Onion powder	373
3/99/4	Mustard flour	375

Class/ Subclass/ Chronological Code	Item	Former QR&EC Code Number
4/1/0	Candy	284
4/1/1	Chocolate nut roll	295
4/1/2	Orange nut roll	309
4/2/0	Chewing gum	287
4/3/0	Chocolate sweet chocolate	060
4/4/0	Chocolate and sweet chocolate	060
4/5/0	Chocolate syrup	062
4/5/1	Molasses	101
4/5/2	Syrup, refiners	233
4/5/3	Syrup, maple	234
4/5/4	Syrup, extra heavy	316
4/5/5	Syrup, heavy	317
4/5/6	Syrup, light	318
4/5/7	Sl. sweetened water	319
4/5/8	Corn syrup	334
4/6/0	Sugar, brown	248
4/6/1	Sugar, refined	249
4/99/0	Honey	124
4/99/1	Marshmallows	148
4/99/2	Meringue powder	157
4/99/3	Chocolate confections	285
5/1/0	Butter	035
5/2/0	Cheese, american, processed	048
5/2/1	Cheese bar	049
5/2/2	Cheese, parmesan	050
5/2/3	Cheese, romano	051
5/2/4	Cheese, cottage	052
5/2/5	Cheese, cheddar	053
5/2/6	Cheese, spread, cheddar	054
5/2/7	Cheese, swiss	055
5/2/8	Colby cheese	352
5/3/0	Cream	076
5/4/0	Eggs	085

Class/ Subclass/ Chronological Code		Former QR&EC Code Number
5/6/0	Buttermilk	036
5/6/1	Chocolate milk	061
5/6/2	Milk	158
5/6/3	Chocolate milk	294
5/6/4	Skim milk	358
5/99/0	Granular or stirred milk curd	351
5/99/1	Washed or soaked milk cereal	353
5/99/2	Cream and milk solids	357
6/1/0	Fatbacks, dry-salt and cured	091
6/1/1	Oil, peanut	168
6/1/2	Olive oil	171
6/1/3	Shortening	231
6/1/4	Corn oil	362
6/1/5	Cottonseed oil	363
6/1/6	Coconut oil	364
6/1/7	Peanut oil	365
6/1/8	Soybean oil	366
6/1/9	Vegetable oil	367
6/2/0	Salad oil	214
6/3/0	Margarine	146
6/3/1	Oleomargarine	170
6/3/2	Peanut oil	181
6/4/0	Mayonnaise	149
6/99/0	Milk fat	159
6/99/1	Edible fat, not more than 0.6% lechithin	345
7/1/0	Blackberries	028
7/1/1	Blueberries	029
7/1/3	Cranberries	074
7/1/4	Pineapple	192
7/1/5	Raspberries	209
7/1/6	Strawberries	246
7/2/0	Grapefruit	112
7/2/1	Lemons	137
7/2/2	Limes	140
7/2/3	Oranges	176
7/2/4	Tangerines	251

Class/ Subclass/ Chronological Code	Item	Former QR&EC Code Number
7/3/0	Apple butter	003
7/3/1	Cranberry sauce	075
7/3/2	Fruit candied	103
7/3/3	Jams (preserves), fruit	129
7/3/4	Jellies, fruit	130
7/3/5	Marmalades, orange	147
7/4/0	Almond paste	001
7/4/1	Nuts, mixed	166
7/4/2	Pecans	184
7/4/3	Walnuts	268
7/5/0	Apples	005
7/5/1	Apricots	008
7/5/2	Avacados	011
7/5/3	Bananas	014
7/5/4	Cantaloupes	039
7/5/5	Cherries	056
7/5/6	Coconut	065
7/5/7	Dates	080
7/5/8	Figs	093
7/5/9	Melons, Casaba and Persian type	155
7/5/10	Melons, honey dew and honey ball	156
7/5/11	Peaches	180
7/5/12	Pears	182
7/5/13	Plums	193
7/5/14	Prunes	204
7/5/15	Pumpkin	205
7/5/16	Raisins	208
7/5/17	Watermelons	269
7/5/18	Grapes	113
7/99/0	Fruit cocktail	
7/99/1	Fruit mix	105
7/99/2	Mincemeat	160
7/99/3	Pie fillings, fruit prepared	189
8/1/0	Beef	022
8/1/1	Beef, corned	023
8/1/2	Beef liver	024
8/1/3	Hearts, beef	122
8/1/4	Kidneys, beef	132
8/1/5	Beef, parboiled, steam-roasted, canned	279
8/1/6	Beef, spiced, with sauce, canned	280
8/1/7	Beefsteak, canned	281
8/1/8	Beef with gravy, canned	283

Class/ Subclass/ Chronological Code	Item	Former QR&EC Code Number
8/2/0	Fish	094
8/2/1	Salmon	215
8/2/2	Sardines	217
8/2/3	Tuna fish	260
8/3/0	Meat loaf	153
8/3/1	Scrapple	229
8/3/2	Chicken and noodles, canned	288
8/3/3	Meat, ground, and spaghetti, canned	308
8/4/0	Bologna	030
8/4/1	Frankfurters	102
8/4/2	Hamburgers	120
8/4/3	Headcheese	121
8/4/4	Lebanon style bologna	134
8/4/5	Luncheon loaf, pickle and pimento	142
8/4/6	Luncheon loaf	143
8/4/7	Meat food product bar	150
8/4/8	Meat food product loaf	151
8/4/9	Meat food product loaf, jellied	152
8/4/10	Pork, luncheon loaf	197
8/4/11	Pork sausage	198
8/4/12	Sausage, beef and pork	220
8/4/13	Sausage, cervelat	221
8/4/14	Sausage, farmer (dry type)	222
8/4/15	Sausage, liver	223
8/4/16	Sausage, New England	224
8/4/17	Sausage, pork	225
8/4/18	Sausage, salami	226
8/4/19	Sausage, Vienna style	227
8/4/20	Hamburgers, canned	304
8/5/0	Chili con carne	058
8/5/1	Beef and peas, canned	277
8/5/2	Beef and vegetables with gravy, canned	278
8/5/3	Beefsteak and potatoes, canned	282
8/5/4	Chicken and vegetables, canned	289
8/5/5	Chili con carne	291
8/5/6	Chili con carne with beans	292
8/5/7	Chili con carne without beans	293
8/5/8	Ham and potatoes, canned	302
8/5/9	Hash, corned beef	305
8/5/10	Meat and corn, canned	306
8/5/11	Meat balls with beans, canned	307

Class/ Subclass/ Chronological Code	Item	Former QR&EC Code Number
8/6/0	Bacon	012
8/6/1	Ham	119
8/6/2	Pigs' feet	191
8/6/3	Pork	194
8/6/4	Pork bellies	195
8/6/5	Pork jowls	196
8/6/6	Ham, sliced and fried, canned	303
8/6/7	Pork and gravy	311
8/6/8	Pork steak	312
8/7/0	Chicken	057
8/7/1	Duck	084
8/7/2	Goose	117
8/7/3	Guinea	118
8/7/4	Squab	243
8/7/5	Turkey	261
8/7/6	Chicken, boned, canned	290
8/8/0	Clams	063
8/8/1	Crab meat	072
8/8/2	Oysters	177
8/8/3	Scallops, sea	228
8/8/4	Shrimp	232
8/9/0	Veal and calf	263
8/10/0	Lamb	133
8/99/0	Liver	141
8/99/1	Rabbits	206
8/99/2	Tongue	258
8/99/3	Ham and eggs, canned	301
9/1/0	Asparagus	010
9/1/1	Beans sprouts	021
9/1/2	Broccoli	033
9/1/3	Brussels sprouts	034
9/1/4	Cabbage	037
9/1/5	Celery	043
9/1/6	Endive	087
9/1/7	Escarole	088
9/1/8	Greens, collard	114
9/1/9	Greens, leafy	115
9/1/10	Greens, mustard and turnip	116

Class/ Subclass/ Chronological Code	Item	Former QR&EC Code Number
9/1/11	Kale	131
9/1/12	Lettuce	138
9/1/13	Parsley	178
9/1/14	Romaine	213
9/1/15	Spinach	244
9/2/0	Artichokes	009
9/2/1	Beans, dried	016
9/2/2	Beans, green	017
9/2/3	Beans, wax	018
9/2/4	Beans, kidney	019
9/2/5	Beans, lima	020
9/2/6	Cauliflower	042
9/2/7	Corn	068
9/2/8	Cucumbers	078
9/2/9	Egg plants	086
9/2/10	Hops	125
9/2/11	Okra	169
9/2/12	Peas	183
9/2/13	Peppers, green	185
9/2/14	Peppers, red	186
9/2/15	Peppers, sweet	187
9/2/16	Squash	245
9/2/17	Succotash	247
9/2/18	Tomatoes	257
9/2/19	Tomatoes and okra, canned	315
9/2/20	Beans, white	
9/3/0	Beets	025
9/3/1	Chicory	089
9/3/2	Onions	173
9/3/3	Parsnips	179
9/3/4	Potatoes, sweet	199
9/3/5	Potatoes, white	200
9/3/6	Radishes	207
9/3/7	Rhubarb	212
9/3/8	Swiss chard	250
9/3/9	Potato sticks	313
9/4/0	Bouillon	031
9/4/1	Soup and gravy base	235
9/4/2	Soup, dehydrated	236
9/4/3	Soups, canned	237

Class/ Subclass/ Chronological Code	Item	Former QR&EC Code Number
9/5/0	Beans, kidney and ham in sauce, canned	275
9/5/1	Beans with frankforts, chunks, canned	276
9/99/0	Mushrooms	163
9/99/1	Olives	172
9/99/2	Shallots, green	230
9/99/3	Tomato paste	255
9/99/4	Tomato puree	256
9/99/5	Vegetables, dehydrated	264
9/99/6	Vegetables, pureed	265
9/99/7	Vegetables, mixed	266
10/3/0	Dessert, powders, gelatin	083
10/99/0	Antitoxidant compound	002
10/99/1	Dessert product (imitation ice cream)	081
10/99/2	Feedstuffs	092
10/99/3	Ice cream mix	128
10/99/4	Malt-preparations	145
10/99/5	Water pack	320
10/99/6	Essential oils	323
10/99/7	Emulsifying agents, beverage	324
10/99/8	Sodium benzoate	326
10/99/9	$MgCO_3$	327
10/99/10	$CaCO_3$	329
10/99/11	Calcium silicate	330
10/99/12	Sodium calcium silico-aluminate	331
10/99/13	Sodium silico-aluminate	332
10/99/14	Potassium iodide	333
10/99/15	Sorbtan monostearate	347
10/99/16	Polyoxgethylene sorbitan monostearate	348
10/99/17	Thiamin hydrochloride	349
10/99/18	Emulsifying agents, cheese	355
10/99/19	Acidifying agents, cheese	356
10/99/20	Lactose	358
10/99/21	Disodium phosphate	359
10/99/22	Sodium citrate	360
10/99/23	Sodium hexametaphosphate	361
10/99/24	Diocetyl, butter flavor	369
10/99/25	Emulsifying agents, morgasine	370
10/99/26	Vitamin A	371
10/99/27	Pickle solution, meat	372
11/1/0	B-1 Unit, meal, combat individual	376

Table 2

PROCESSING CODES

Class	Description	Number of Items
0	Cooking processes	15
1	Flavoring processes	10
2	Preserving processes	18
3	Packing-related processes	7
4	Preparation processes	12
5	Breaking-up processes	12
6	Miscellaneous	14

Class/Chronological Code	Item	Former QR&EC Code Number
0/0	Raw	693
0/1	Creamed	917
0/2	Pureed	958
0/3	Cooked	237
0/4	Seared	957
0/5	Sauted	218
0/6	Barbecued	594
0/7	Browned	628
0/8	Simmered	238
0/9	Stewed	217
0/10	Boiled	685
0/11	Roasted	424
0/12	Broiled	662
0/13	Pre-fried	902
0/14	Braised	743
1/0	Unflavored	079
1/1	Seasoned	086
1/2	Sweetened	112
1/3	Salted	175
1/4	Topped	332
1/5	Glazed	666
1/6	Pan Coated	680
1/7	Chocolate coated	052
1/8	Stuffed	909
1/9	Filled	410
2/0	Fresh	430
2/1	Canned	299
2/2	Chilled	352
2/3	Frozen	382
2/4	Freeze dehydrated	725
2/5	Dessicated	904
2/6	Drain dried	160
2/7	Spray dried	311
2/8	Puff dried	683
2/9	Foam mat dried	745
2/10	Roller dried	274
2/11	Dehydrated	169
2/12	Smoked	887
2/13	Irradiated	097
2/14	Injection cured	345
2/15	Dry sugar cured	912
2/16	Box cured	602
2/17	Salted	277

Class/Chronological Code	Item	Former QR&EC Code Number
3/0	Concentrated	266
3/1	Compressed	082
3/2	Pressed	794
3/3	Molded	807
3/4	Disk	555
3/5	Bar	162
3/6	Packed in container	
4/0	Washed	687
4/1	Centrifuged	316
4/2	Bleached	269
4/3	Shelled	034
4/4	Boned	536
4/5	Peeled	163
4/6	Spinned	693
4/7	Sonded	149
4/8	Blanched	235
4/9	Loft dried	003
4/10	Macerated	378
4/11	Soaked	710
5/0	French cut	551
5/1	Cross cut	678
5/2	Halved	740
5/3	Chopped	240
5/4	Sliced	566
5/5	Crushed	702
5/6	Ground	234
5/7	Shredded	181
5/8	Powdered	576
5/9	Diced	630
5/10	Flaked	167
5/11	Granulated	977
6/0	Ready to cook	084
6/1	Strained	125
6/2	Blended	641
6/3	Mixed	956
6/4	Unpopped	204
6/5	Oven puffed	498
6/6	Gun puffed	968
6/7	Fermented	146
6/8	Unfermented	815
6/9	Prepared	319

Class/Chronological Code	Item	Former QR&EC Code Number
6/10	Refined	625
6/11	Iodized	412
6/12	Evaporated	112
6/13	Prefabricated	852

Table 3

PACKAGING CODES

Class	Description	Number of Items
0	Alphabetic designations	6
1	Cans	8
2	Films, bags, cellophanes, etc.	7
3	Cloths	3
4	Foils and papers	9
5	Cartons	5
6	Boxes	4
7	Packages	4
8	Atmosphere	2

Class/Chronological Code	Item	Former QR&EC Code Number
0/0	300 gage LSAT	084
0/1	MSAT 80	070
0/2	MSAT 82	018
0/3	MSAT 86	728
0/4	DSB	887
0/5	450 gage MSAT 83	936
1/0	Style 1 can	537
1/1	Style 1b can	633
1/2	Style 2 can	353
1/3	Style 3 can	634
1/4	Style 4 can	982
1/5	Style 5 can	026
1/6	Style 6 can	645
1/7	Style 6b can	850
2/0	Polyethylene bag	585
2/1	Plastic film made from blend of polyvinyl chloride with nitrile	029
2/2	Plastic film made from blend of vinyl chloride with Buna-n type rubber	498
2/3	Plastic, rubber hydrochloride base	629
2/4	Cellophane	433
2/5	Waxed glassine	359
2/6	Waxed glassine, aluminum foil laminate	377
3/0	Muslin	504
3/1	Osnaburg cloth	226
3/2	Burlap	962
4/0	Oil paper	348
4/1	Parchment paper	039
4/2	Wet strength paper	451
4/3	Waxed paper	967
4/4	Creped waxed paper	317
4/5	Crinkled waxed paper	786
4/6	Puckered parchmentized paper	843
4/7	Laminated aluminum foil, wax sulphite tissue combination	518
4/8	Aluminum foil	01

Class/Chronological Code	Item	Former QR&EC Code Number
5/0	Tight wrapped carton	366
5/1	Overwrapped carton	072
5/2	Laminated board carton	101
5/3	Wax coated carton	551
5/4	Wax dipped carton	538
6/0	Corrugated box	846
6/1	Fiber board box	181
6/2	Nailed wood box	796
6/3	Wire bound box	759
7/0	Container	
7/1	Foil packet	
7/2	Component of a ration	
7/3	Food packet	
8/0	Air	
8/1	Nitrogen	

Table 4

TEST PROCEDURE CODES

Class/ Subclass	Description	Number of Items
Class 1	Proximate Composition	
1/1	Moistures	11
1/2	Protein	11
1/3	Fat	7
1/4	Ash	5
1/5	Carbohydrates	12
Class 2	Mineral Composition	
2/1	Metals	18
2/2	Non-metals	20
Class 3	Organic Compound Composition	
3/1	Aldehydes	7
3/2	Alcohols	7
3/3	Acids	16
3/4	Esters	3
3/5	Ketones	2
3/6	Amines	4
3/7	Enzymes	6
3/8	Amino acids	12
3/9	Preservatives and sweeteners	17
3/10	Extraneous materials	12
3/11	Vitamins	8
3/12	Gases	9
Class 4	Physical Characteristics	
4/1	Weight-volume	7
4/2	Temperature	7
4/3	Color	3
4/4	Spectro-analysis	2
4/5	Texture	3
4/6	Viscosity	5
4/7	Surface tension	2
4/8	Pressure	2
4/9	Refractometry	

Class/ Subclass	Description	Number of Items
Class 5	Chemical Characteristics	
5/1	Fat	10
5/2	Gross	3
5/3	Carbohydrates	12
Class 6	Deterioration	
6/1	Oxidative	4
6/2	Hydrolytic	2
6/3	Browning	3
6/4	Electrolytic	1
Class 7	Subjective	
7/1	Sensory	4
7/2	Intensity	10
7/3	Technological	4

Class/ Subclass/ Chronological Code	Item
1/1/1	AOM/104°C/ 4 hrs.*
1/1/2	AOM/100°C/ 6 hrs.
1/1/3	AOM/130°C/ 1 hr.
1/1/4	AOM/135°C/ 1 hr.
1/1/5	VOM/100°C/ 3 hrs.**
1/1/6	VOM/100°C/ 6 hrs.
1/1/7	VOM/ 70°C/16 hrs.
1/1/8	Immiscible solvent - distillation method
1/1/9	Sulfuric acid method
1/1/10	MPC
1/1/11	Karl Fischer Method
1/2/1	6.38 Kjeldahl
1/2/2	6.25 Kjeldahl
1/2/3	5.70 Kjeldahl
1/2/4	5.80 Kjeldahl
1/2/5	6.31 Kjeldahl
1/2/6	5.83 Kjeldahl
1/2/7	5.95 Kjeldahl
1/2/8	5.30 Kjeldahl
1/2/9	5.18 Kjeldahl
1/2/10	5.46 Kjeldahl
1/2/11	5.71 Kjeldahl
1/3/1	Acid hydrolysis
1/3/2	Alkaline hydrolysis
1/3/3	Soxhlet
1/3/4	Bobcock
1/3/5	Detergent
1/3/6	Perchloric acid
1/3/7	Extraction
1/4/1	550°C
1/4/2	Wet
1/4/3	Insoluble
1/4/4	Soluble
1/4/5	Alkalinity

*Air over method
**Vacuum over method

Class/ Subclass/ ical Code	Item
1/5/1	Crude fiber
1/5/2	Dextrose
1/5/3	Dextrin
1/5/4	Invert sugar before hydrolysis
1/5/5	Invert sugar after hydrolysis
1/5/6	Reducing sugars
1/5/7	Sucrose
1/5/8	Fructose
1/5/9	Lignin
1/5/10	Lactose
1/5/11	Maltose
1/5/12	Starch
2/1/1	Aluminum
2/1/2	Calcium
2/1/3	Cobalt
2/1/4	Copper
2/1/5	Cadmium
2/1/6	Iron
2/1/7	Magnesium
2/1/8	Manganese
2/1/9	Molybdenum
2/1/10	Mercury
2/1/11	Potassium
2/1/12	Sodium
2/1/13	Tin
2/1/14	Zinc
2/1/15	Lead
2/1/16	Barium
2/1/17	Strontium
2/1/18	Lithium
2/2/1	Arsenic
2/2/2	Boron
2/2/3	Soluble phosphorous
2/2/4	Insoluble phosphorous
2/2/5	Total phosphorous
2/2/6	Lipid phosphorous
2/2/7	Sulphur
2/2/8	Sulfide
2/2/9	Ammonium
2/2/10	Chloride
2/2/11	Sulfates
2/2/12	Borates
2/2/13	Iodides

Class/ Subclass/ Chronological Code	Item
2/2/14	Fluorides
2/2/15	Hydrogen sulfide
2/2/16	Carbonates
2/2/17	Silica
2/2/18	Nitrate
2/2/19	Nitrites
2/2/20	Sulfites
3/1/1	Acetaldehyde
3/1/2	Peuzaldehyde
3/1/3	Formaldehyde
3/1/4	Furfural
3/1/5	Total aldehydes
3/1/6	Gamma undecalactone
3/1/7	Vanillin
3/2/1	Methanal
3/2/2	Ethanol
3/2/3	Glycerol
3/2/4	Isopropyl
3/2/5	Sterols
3/2/6	Tert. Butyl
3/2/7	Fusel oil
3/3/1	Acetic
3/3/2	Butyric
3/3/3	Formic
3/3/4	Citric
3/3/5	Nalic
3/3/6	Benzoic
3/3/7	Propionic
3/3/8	Tartaric
3/3/9	Iso-citric
3/3/10	Chlorogenic
3/3/11	Lactic
3/3/12	Succinic
3/3/13	Uric
3/3/14	Inactive malic
3/3/15	Creatin
3/3/16	Pectic
3/4/1	Ethyl acetate
3/4/2	Linalyl acetate
3/4/3	Methyl anthionilate

Class/ Subclass/ Chronological Code	Item
3/5/1	Acetone
3/5/2	Thujone
3/6/1	Caffeine
3/6/2	Total amine
3/6/3	1° amine
3/6/4	2° amine
3/7/1	Catalase
3/7/2	Amylase
3/7/3	Phosphotase
3/7/4	Proteinase
3/7/5	Lipase
3/7/6	Lipoxidase
3/8/1	Van Slyke
3/8/2	Sorenson
3/8/3	Arginine
3/8/4	Histidine
3/8/5	Threonine
3/8/6	Valine
3/8/7	Leucine
3/8/8	Isoleucine
3/8/9	Lysine
3/8/10	Methionine
3/8/11	Phenylalanine
3/8/12	Tryptophane
3/9/1	Propyl gallate
3/9/2	Sulphur dioxide
3/9/3	Nitrate
3/9/4	Nitrites
3/9/5	Benzoic acid
3/9/6	Boric acid
3/9/7	Borates
3/9/8	Formaldehyde
3/9/9	Formic acid
3/9/10	Hydrogen peroxide
3/9/11	Iodates
3/9/12	Salicylic acid
3/9/13	Quaternary ammonium compounds
3/9/14	Cyclohexulsulfante salts
3/9/15	Dulcin
3/9/16	Propionates
3/9/17	Saccharin

Class/ Subclass/ Chronological Code	Item
3/10/1	Mold count
3/10/2	Insect eggs
3/10/3	Insect fragments, rodent contamination
3/10/4	Filth
3/10/5	Sediment test
3/10/6	Water-insoluble inorganic residue
3/10/7	Insect excreta
3/10/8	Insect infestation
3/10/9	Glass and sand
3/10/10	Rot
3/10/11	Yeast and spores
3/10/12	Standard plate count and auaerobes
3/11/1	A
3/11/2	Carotene
3/11/3	E
3/11/4	B_1
3/11/5	B_2
3/11/6	Ascorbic acid
3/11/7	Dehydo-ascorbic acid
3/11/8	Niacin
3/12/1	Carbon dioxide
3/12/2	Total CO_3
3/12/3	Residual CO_2
3/12/4	Headspace CO_2
3/12/5	Headspace O_2
3/12/6	Headspace N_2
3/12/7	Headspace CO
3/12/8	Headspace H_2
3/12/9	Headspace CH_4
4/1/1	Net contents
4/1/2	Net weight
4/1/3	Net volume
4/1/4	Specific gravity
4/1/5	Density
4/1/6	Bulk density
4/1/7	Sieve test
4/2/1	Freezing point
4/2/2	Wiley method (m.p.)
4/2/3	Capillary tube (m.p.)

Class/ Subclass/ Chronological Code	Item
4/2/4	Titer test
4/2/5	Boiling point
4/2/6	Smoke, flash and fire points
4/2/7	Cold test
4/3/1	Hunter color and color difference meter
4/3/2	"Color eye" colorimeter
4/3/3	Spectrophotometer, visible range
4/4/1	Infra red spectrum
4/4/2	Ultra violet spectrum
4/5/1	Kramer shear press
4/5/2	Warner-Bratzler
4/5/3	GF-texturimeter
4/6/1	Ostwald viscosmeter
4/6/2	UB beholde viscosmeter
4/6/3	Torsion viscosimeter
4/6/4	Farinigraph
4/6/5	Extensograph
4/7/1	Static method
4/7/2	Dynamic method
4/8/1	Vapor pressure
4/8/2	Headspace pressure
4/9/1	Index of refraction
5/1/1	Iodine value
5/1/2	Thiocyanogan value
5/1/3	Saponification value
5/1/4	Acetyl value
5/1/5	Reichert-Meissl value
5/1/6	Polinski value
5/1/7	Saturated acids
5/1/8	Unsaturated acids
5/1/9	Acid value
5/1/10	AOM fat stability
5/2/1	Solubility index
5/2/2	Hydrogen-ion concentration
5/2/3	Acidity

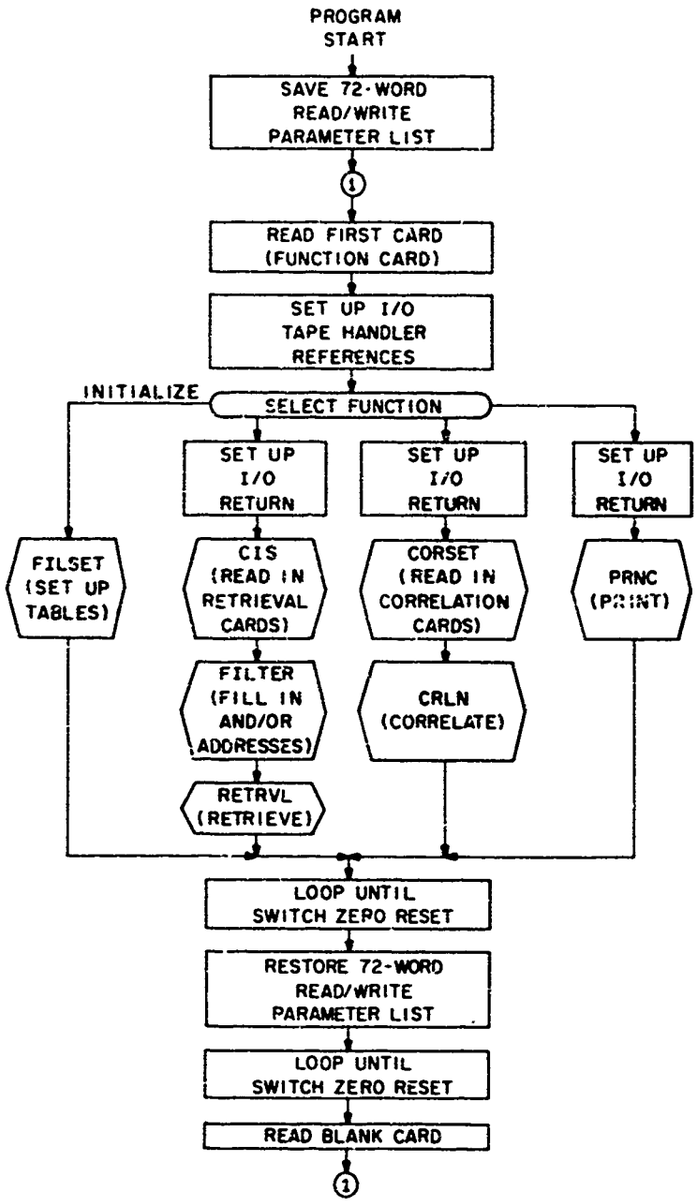
Class/ Subclass/ Chronological Code	Item
5/3/1	Molisch reaction
5/3/2	Anthone reaction
5/3/3	Fehling test
5/3/4	Benedict test
5/3/5	Barford test
5/3/6	Oda zone reaction
5/3/7	Selwanoff reaction
5/3/8	Diazouracil reaction
5/3/9	Mucic acid
5/3/10	Phloroglucinol reaction
5/3/11	Bial orcinol reaction
5/3/12	Lead number
6/1/1	Peroxide value
6/1/2	Oxygen uptake
6/1/3	Carbonyl
6/1/4	TBA
6/2/1	Free fatty acid
6/2/2	Reducing sugars
6/3/1	Fluorescence, saline
6/3/2	Reflectance
6/3/3	Liquid fluorescent
6/4/1	Tin
7/1/1	Hedonic
7/1/2	Paired
7/1/3	Triangle
7/1/4	Duo-Trio
7/2/1	Sweet
7/2/2	Sour
7/2/3	Salt
7/2/4	Bitter
7/2/5	Burnt
7/2/6	Ethereal
7/2/7	Fragment
7/2/8	Spicy
7/2/9	Resinous
7/2/10	Putrid

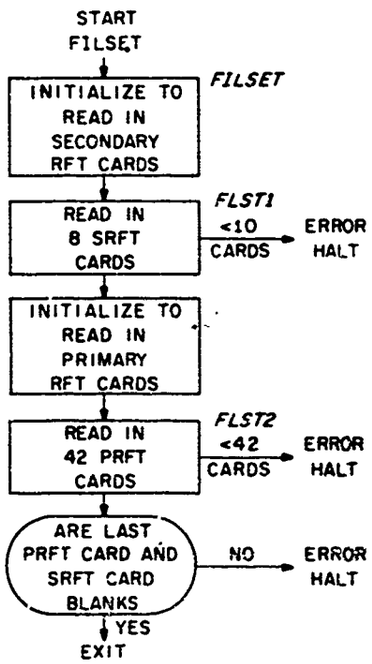
Class/ Subclass/ Chronological Code	Item
7/3/1	General appearance
7/3/2	Odor
7/3/3	Texture
7/3/4	Flavor

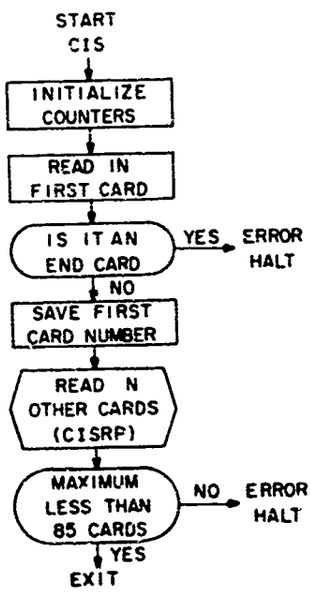
Appendix B

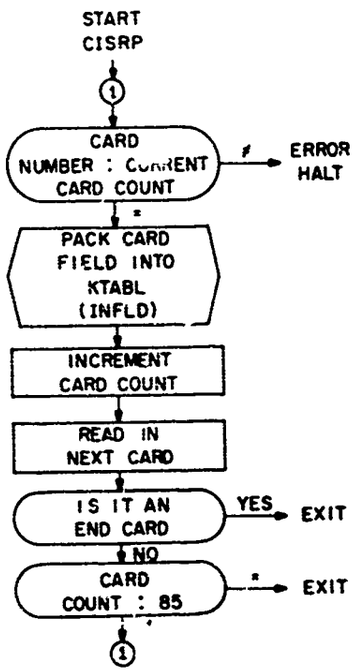
FLOW CHARTS

DRVR	95
FILSET	96
CIS and CISRP	97
INFLD	98
FILTER	99
Pushdown Routines	100
RETRVL	101
DCID	104
DIRED and DIWRI	105
CORSET and CRLN	106
PRNC	107
Memory Layout of Retrieval and Correlation Program	108

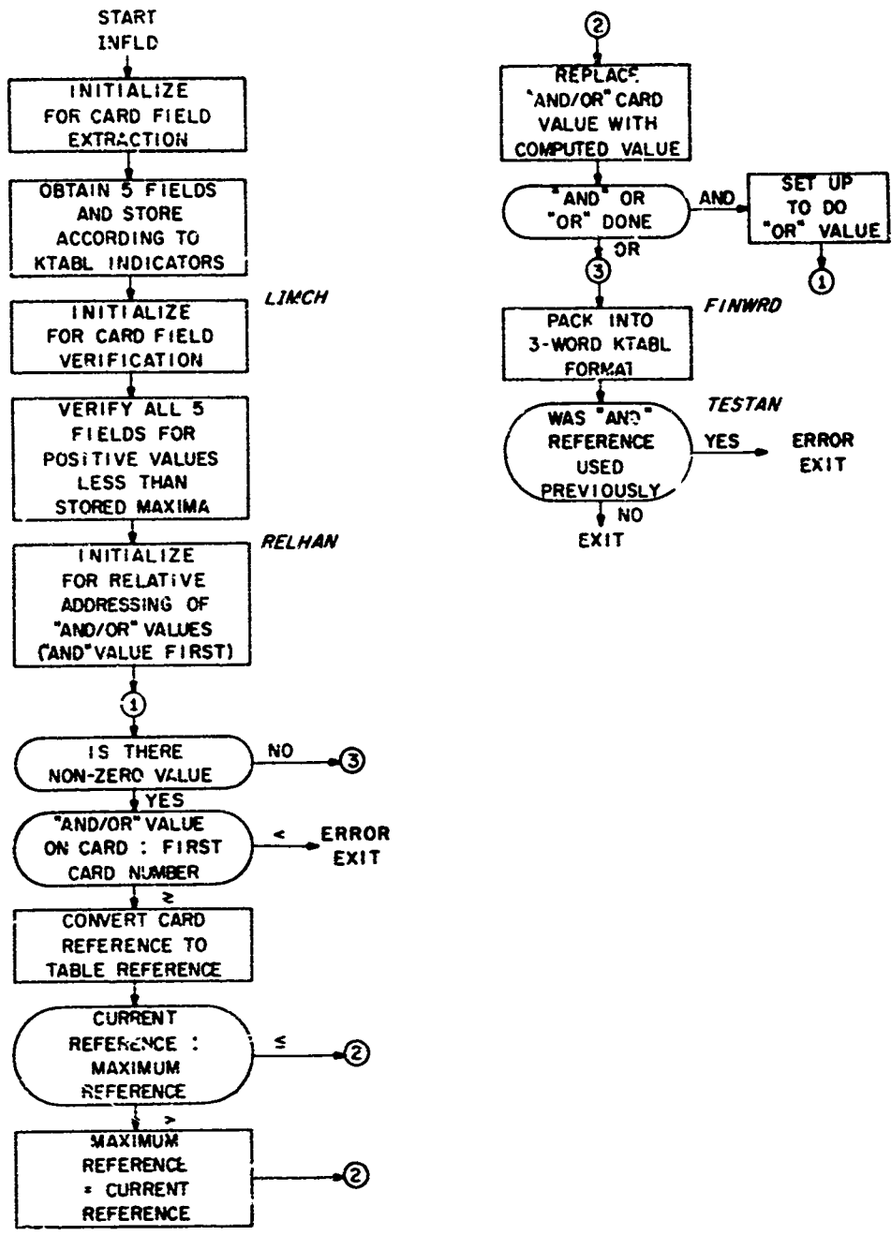

PROGRAM START
SAVE 72-WORD READ/WRITE PARAMETER LIST
1
READ FIRST CARD (FUNCTION CARD)
SET UP I/O TAPE HANDLER REFERENCES
INITIALIZE
SELECT FUNCTION
SET UP I/O RETURN
SET UP I/O RETURN
SET UP I/O RETURN
FILSET (SET UP TABLES)
CIS (READ IN RETRIEVAL CARDS)
CORSET (READ IN CORRELATION CARDS)
PRNC (PRINT)
FILTER (FILL IN AND/OR ADDRESSES)
CRLN (CORRELATE)
RETRVL (RETRIEVE)
LOOP UNTIL SWITCH ZERO RESET
RESTORE 72-WORD READ/WRITE PARAMETER LIST
LOOP UNTIL SWITCH ZERO RESET
READ BLANK CARD
1

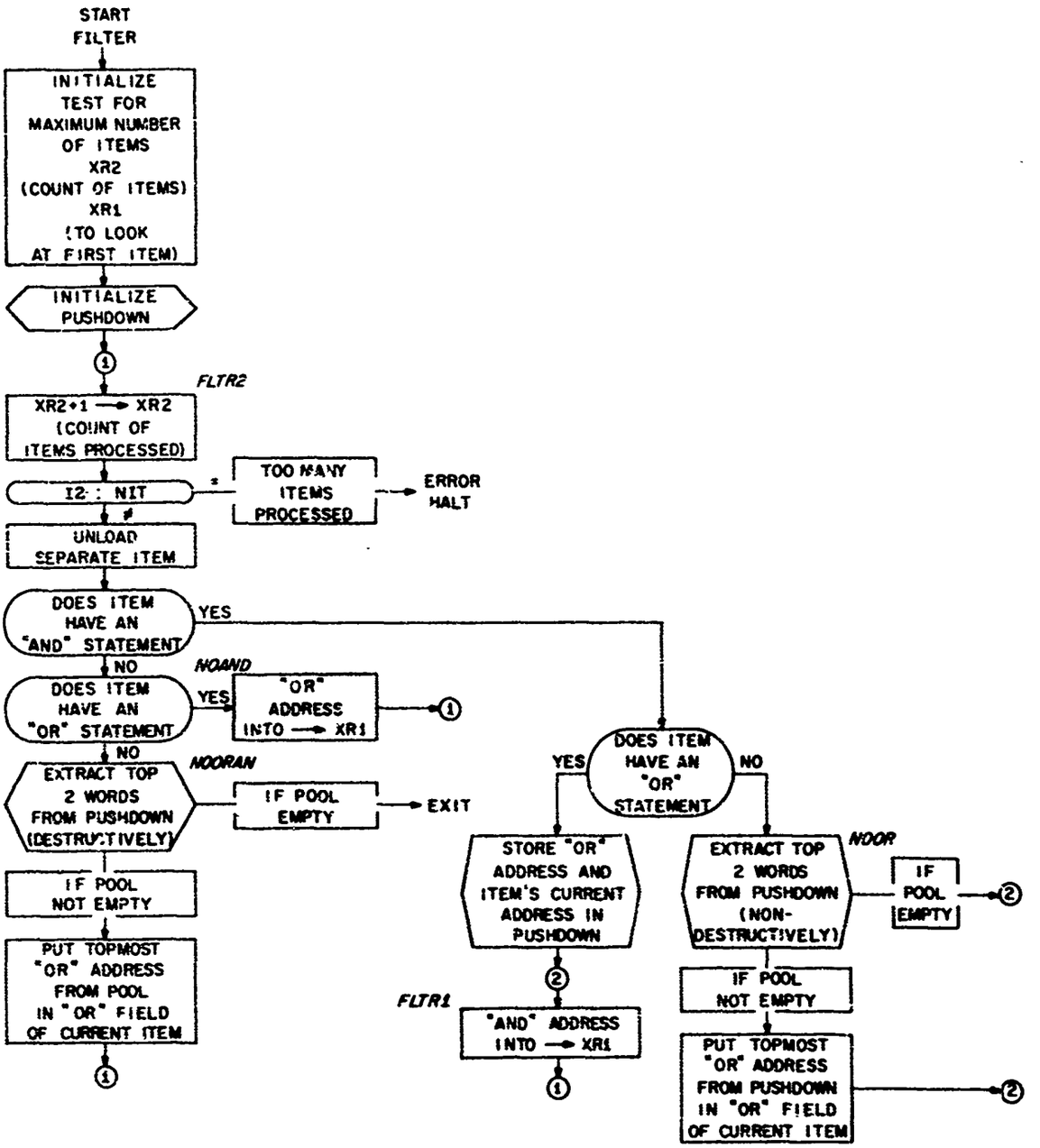

START
FILSET
INITIALIZE TO READ IN SECONDARY RFT CARDS
FILSET
READ IN 8 SRFT CARDS
FLST1
<10 CARDS
ERROR HALT
INITIALIZE TO READ IN PRIMARY RFT CARDS
READ IN 42 PRFT CARDS
FLST2
<42 CARDS
ERROR HALT
ARE LAST PRFT CARD AND SRFT CARD BLANKS
NO
ERROR HALT
YES
EXIT

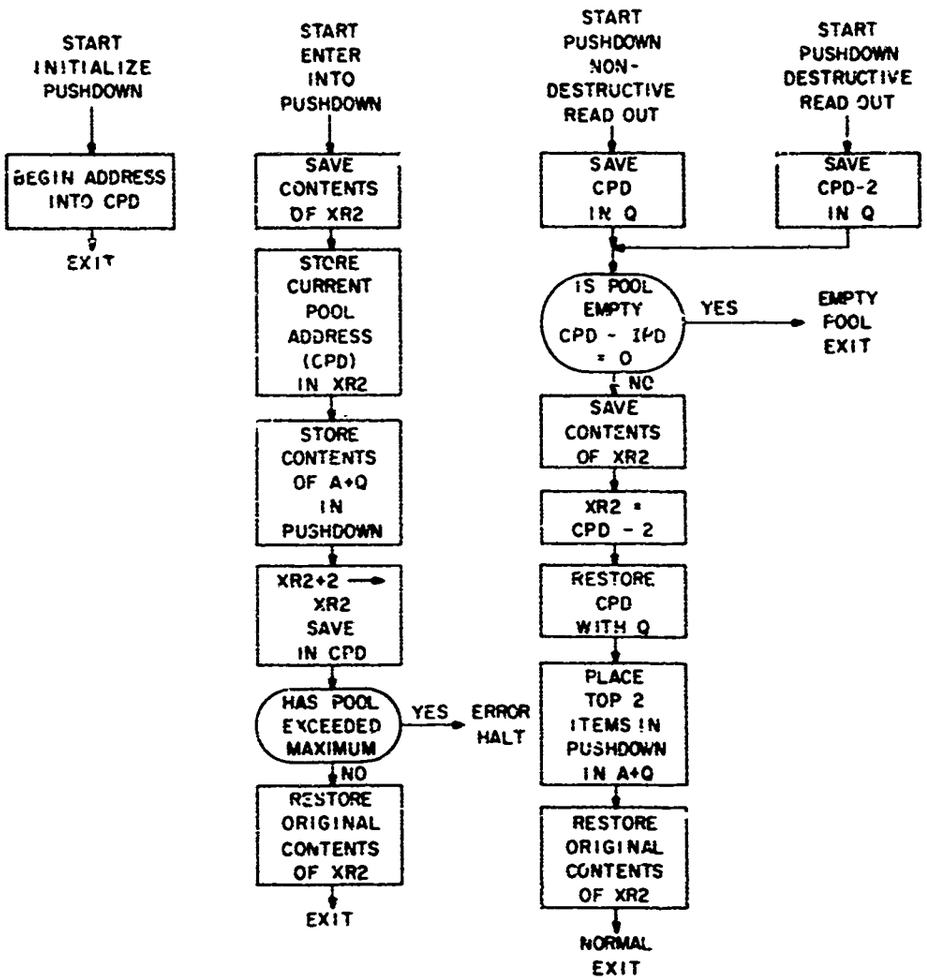




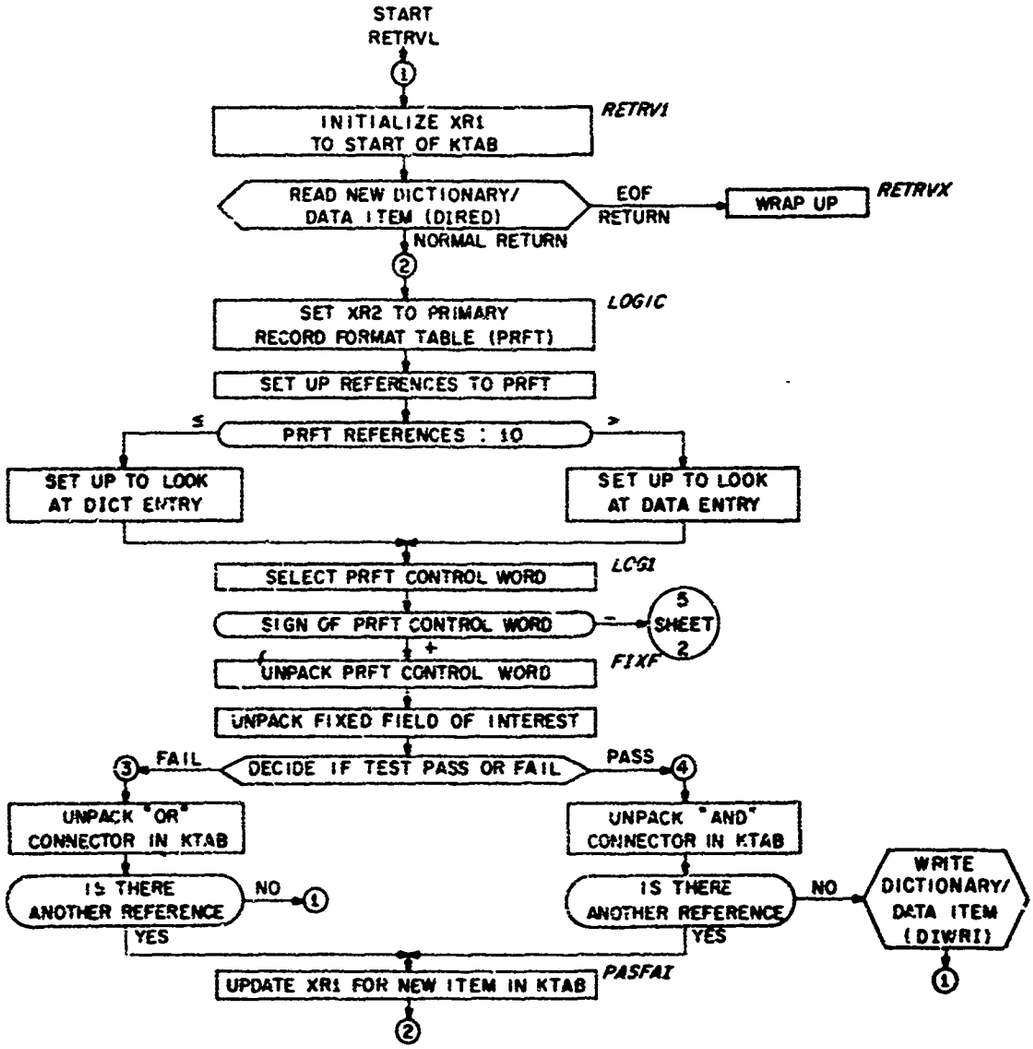
CIS and CISRP


START
INFLD
INITIALIZE FOR CARD FIELD EXTRACTION
OBTAIN 5 FIELDS AND STORE ACCORDING TO KTABL INDICATORS
INITIALIZE FOR CARD FIELD VERIFICATION
LIMCH
VERIFY ALL 5 FIELDS FOR POSITIVE VALUES LESS THAN STORED MAXIMA
INITIALIZE FOR RELATIVE ADDRESSING OF "AND/OR" VALUES ("AND" VALUE FIRST)
RELHAN
1
IS THERE NON-ZERO VALUE
NO
3
YES
"AND/OR" VALUE ON CARD : FIRST CARD NUMBER
<
ERROR EXIT
≥
CONVERT CARD REFERENCE TO TABLE REFERENCE
CURRENT REFERENCE : MAXIMUM REFERENCE
≤
2
>
MAXIMUM REFERENCE = CURRENT REFERENCE
2
REPLACE "AND/OR" CARD VALUE WITH COMPUTED VALUE
"AND" OR "OR" DONE
AND
SET UP TO DO "OR" VALUE
1
OR
3
PACK INTO 3-WORD KTABL FORMAT
FINWRD
WAS "AND" REFERENCE USED PREVIOUSLY
TESTAN
YES
ERROR EXIT
NO
EXIT

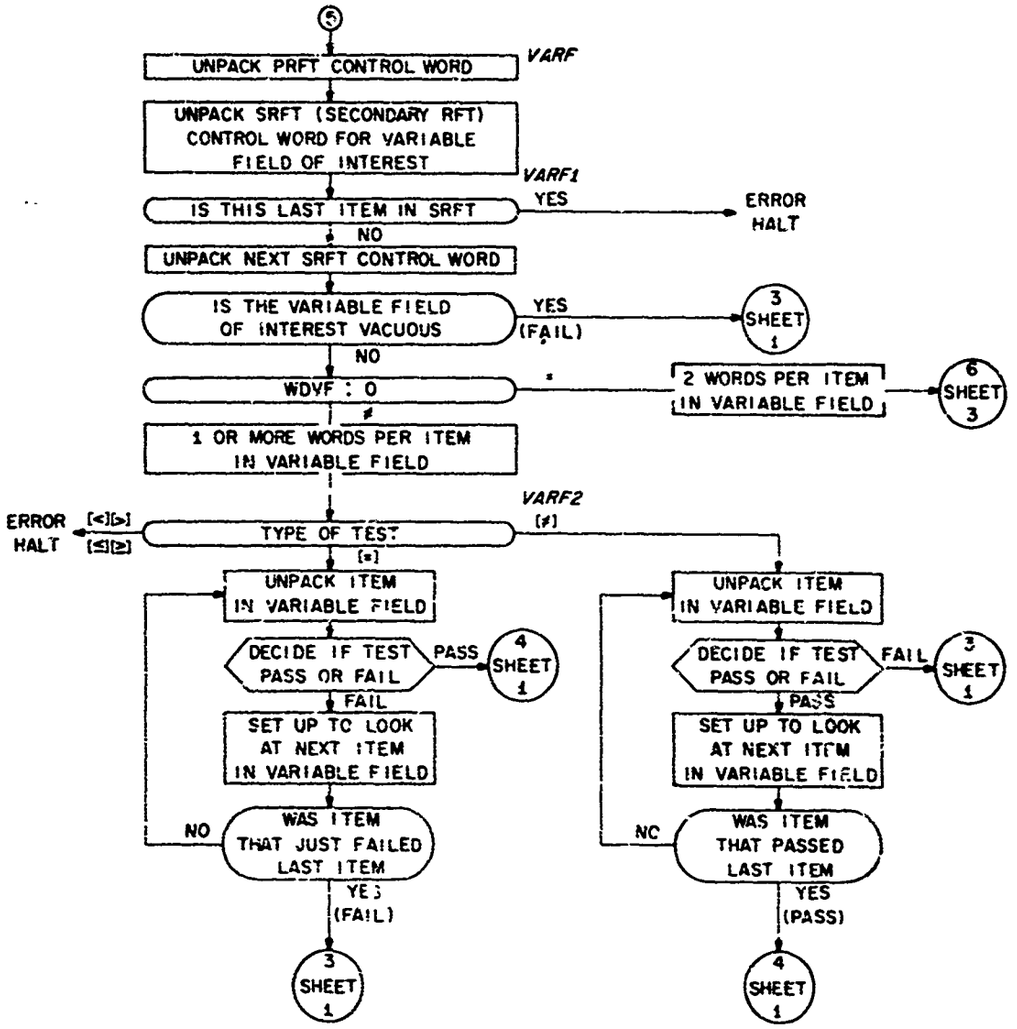

START FILTER
INITIALIZE TEST FOR MAXIMUM NUMBER OF ITEMS XR2 (COUNT OF ITEMS) XR1 (TO LOOK AT FIRST ITEM)
INITIALIZE PUSHDOWN
1
FLTR2
XR2+1 → XR2 (COUNT OF ITEMS PROCESSED)
I2 : NIT
=
TOO MANY ITEMS PROCESSED
ERROR HALT
≠
UNLOAD SEPARATE ITEM
DOES ITEM HAVE AN "AND" STATEMENT
YES
NO
NOAND
DOES ITEM HAVE AN "OR" STATEMENT
YES
"OR" ADDRESS INTO → XR1
1
NO
NOORAN
EXTRACT TOP 2 WORDS FROM PUSHDOWN (DESTRUCTIVELY)
IF POOL EMPTY
EXIT
IF POOL NOT EMPTY
PUT TOPMOST "OR" ADDRESS FROM POOL IN "OR" FIELD OF CURRENT ITEM
1
DOES ITEM HAVE AN "OR" STATEMENT
YES
NO
STORE "OR" ADDRESS AND ITEM'S CURRENT ADDRESS IN PUSHDOWN
2
FLTR1
"AND" ADDRESS INTO → XR1
1
NOOR
EXTRACT TOP 2 WORDS FROM PUSHDOWN (NON-DESTRUCTIVELY)
IF POOL EMPTY
2
IF POOL NOT EMPTY
PUT TOPMOST "OR" ADDRESS FROM PUSHDOWN IN "OR" FIELD OF CURRENT ITEM
2



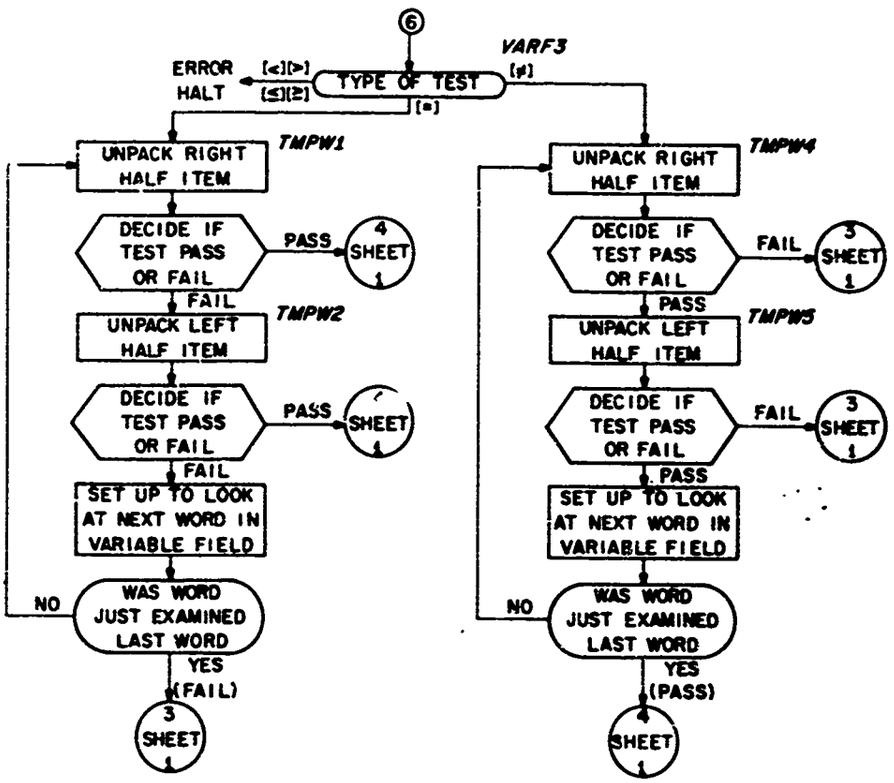
Pushdown Routines



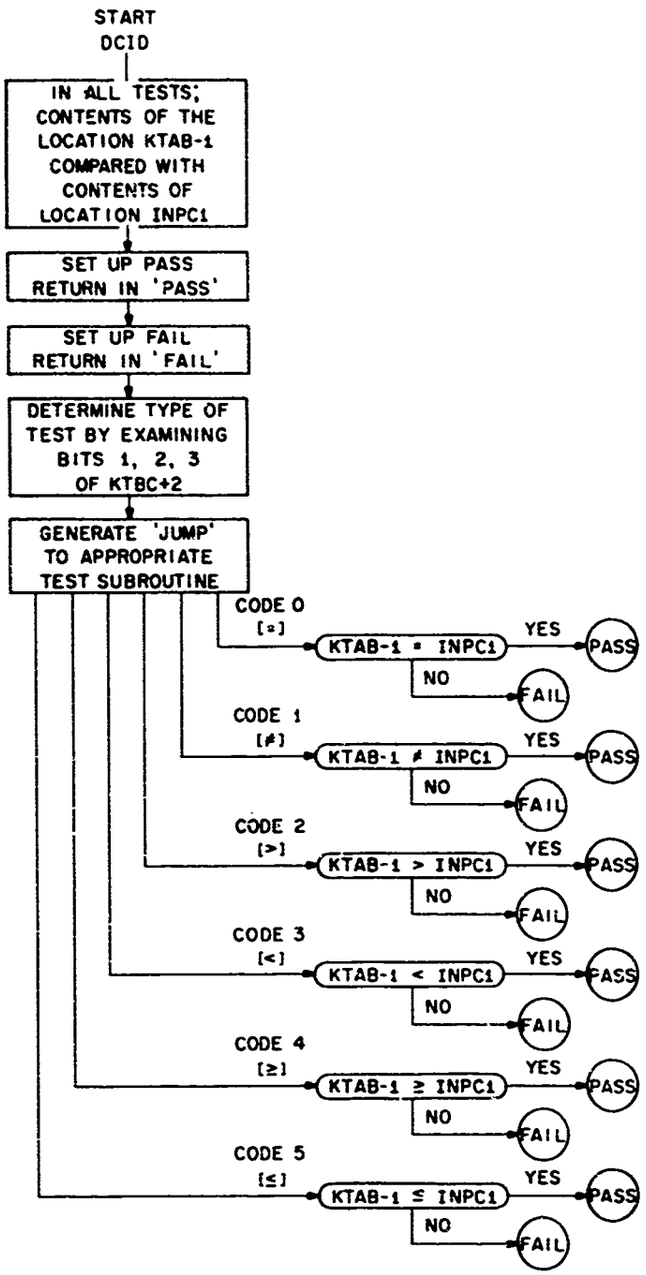
RETRVL
(Part 1 of 3)

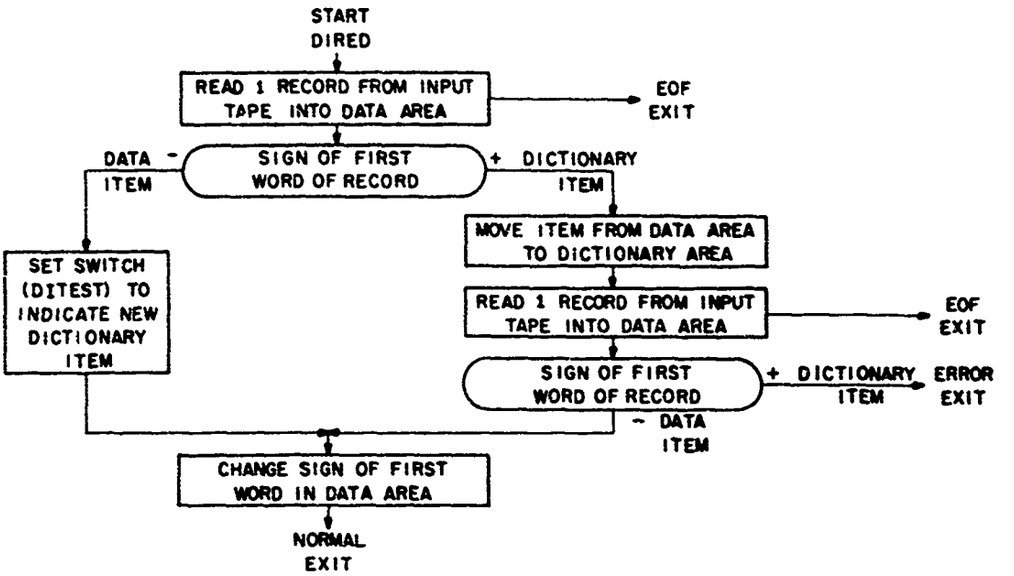


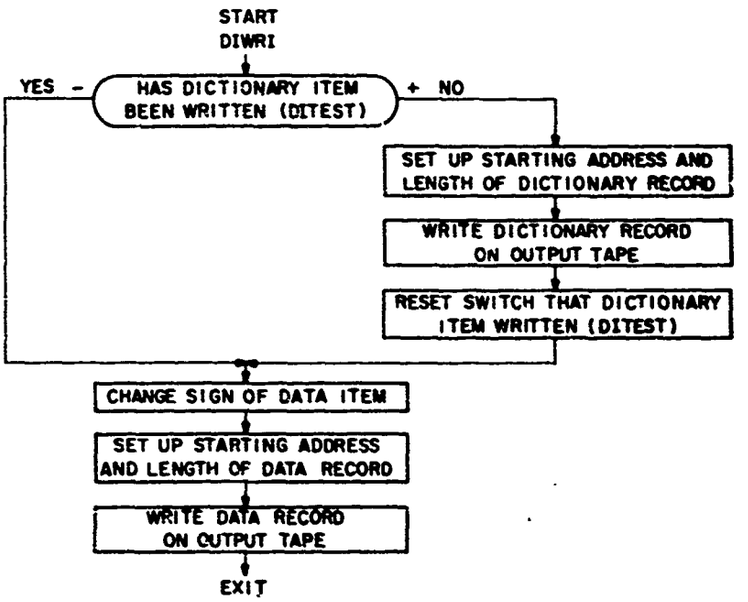
RETRVL
(Part 2 of 3)

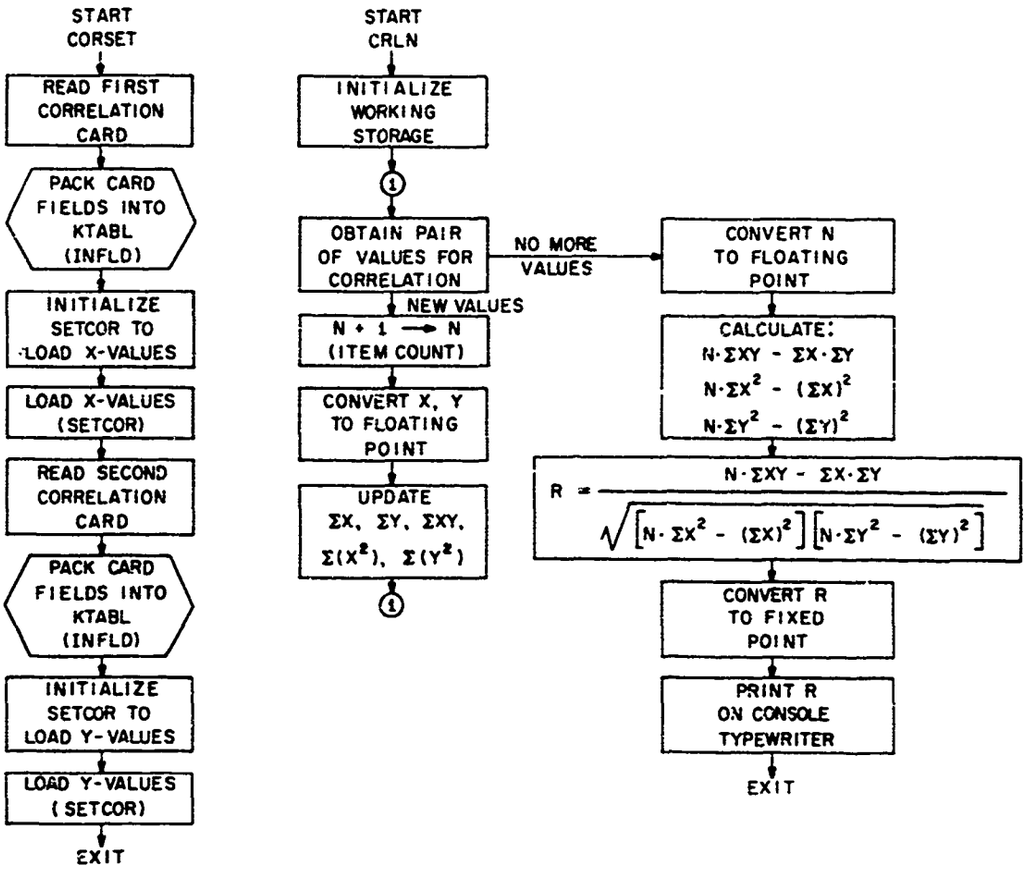


RETRVL
(Part 3 of 3)

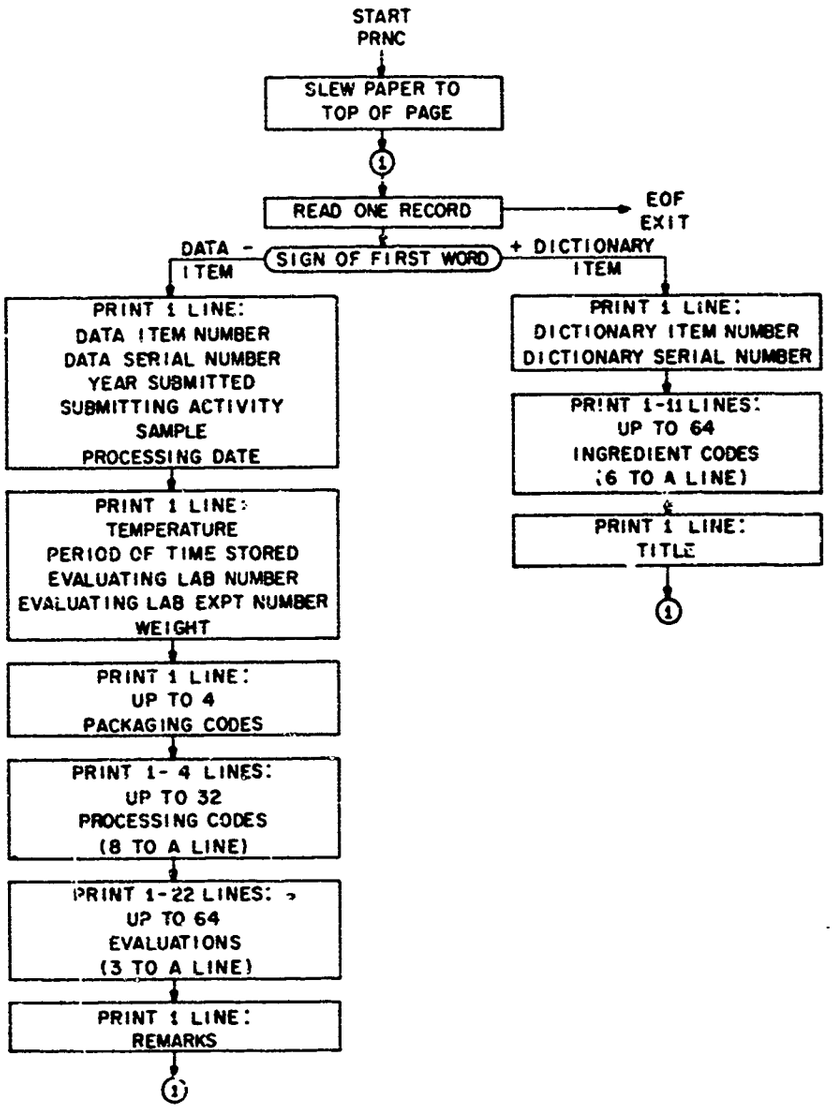

START
DCID
IN ALL TESTS; CONTENTS OF THE LOCATION KTAB-1 COMPARED WITH CONTENTS OF LOCATION INPC1
SET UP PASS RETURN IN 'PASS'
SET UP FAIL RETURN IN 'FAIL'
DETERMINE TYPE OF TEST BY EXAMINING BITS 1, 2, 3 OF KTBC+2
GENERATE 'JUMP' TO APPROPRIATE TEST SUBROUTINE
CODE 0
[=]
KTAB-1 = INPC1
YES
PASS
NO
FAIL
CODE 1
[≠]
KTAB-1 ≠ INPC1
YES
PASS
NO
FAIL
CODE 2
[>]
KTAB-1 > INPC1
YES
PASS
NO
FAIL
CODE 3
[<]
KTAB-1 < INPC1
YES
PASS
NO
FAIL
CODE 4
[≥]
KTAB-1 ≥ INPC1
YES
PASS
NO
FAIL
CODE 5
[≤]
KTAB-1 ≤ INPC1
YES
PASS
NO
FAIL

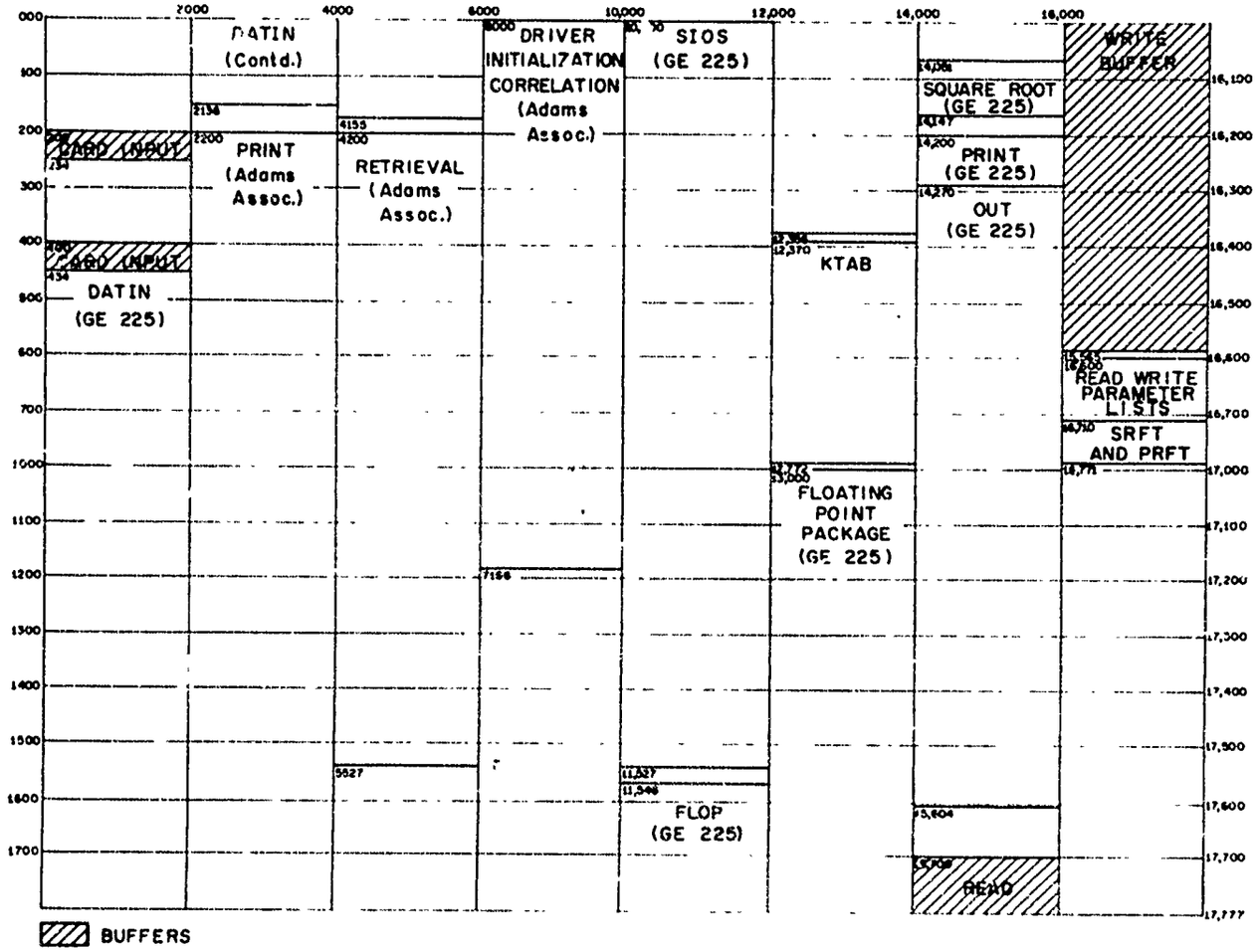

START
DIRED
READ 1 RECORD FROM INPUT TAPE INTO DATA AREA
EOF EXIT
DATA ITEM
SIGN OF FIRST WORD OF RECORD
DICTIONARY ITEM
SET SWITCH (DITEST) TO INDICATE NEW DICTIONARY ITEM
MOVE ITEM FROM DATA AREA TO DICTIONARY AREA
READ 1 RECORD FROM INPUT TAPE INTO DATA AREA
EOF EXIT
SIGN OF FIRST WORD OF RECORD
DICTIONARY ITEM
ERROR EXIT
DATA ITEM
CHANGE SIGN OF FIRST WORD IN DATA AREA
NORMAL EXIT


START
DIWRI
YES
HAS DICTIONARY ITEM BEEN WRITTEN (DITEST)
NO
SET UP STARTING ADDRESS AND LENGTH OF DICTIONARY RECORD
WRITE DICTIONARY RECORD ON OUTPUT TAPE
RESET SWITCH THAT DICTIONARY ITEM WRITTEN (DITEST)
CHANGE SIGN OF DATA ITEM
SET UP STARTING ADDRESS AND LENGTH OF DATA RECORD
WRITE DATA RECORD ON OUTPUT TAPE
EXIT



CORSET and CRLN


START
PRNC
SLEW PAPER TO
TOP OF PAGE
1
READ ONE RECORD
EOF
EXIT
DATA -
ITEM
SIGN OF FIRST WORD
+ DICTIONARY
ITEM
PRINT 1 LINE:
DATA ITEM NUMBER
DATA SERIAL NUMBER
YEAR SUBMITTED
SUBMITTING ACTIVITY
SAMPLE
PROCESSING DATE
PRINT 1 LINE:
TEMPERATURE
PERIOD OF TIME STORED
EVALUATING LAB NUMBER
EVALUATING LAB EXPT NUMBER
WEIGHT
PRINT 1 LINE:
UP TO 4
PACKAGING CODES
PRINT 1- 4 LINES:
UP TO 32
PROCESSING CODES
(8 TO A LINE)
PRINT 1-22 LINES:
UP TO 64
EVALUATIONS
(3 TO A LINE)
PRINT 1 LINE:
REMARKS
1
PRINT 1 LINE:
DICTIONARY ITEM NUMBER
DICTIONARY SERIAL NUMBER
PRINT 1-11 LINES:
UP TO 64
INGREDIENT CODES
(6 TO A LINE)
PRINT 1 LINE:
TITLE
1



Memory Layout of Retrieval and Correlation Program

Appendix C

G.E. SUBROUTINES IN RETRIEVAL AND CORRELATION PROGRAM

CD225C2.000	Binary to BCD Conversion (FLOP)	PRNC
CD225D1.002	Floating Point Package (CFP, FAD, FSB, FMP, FDV)	DCID
CD225D2.007	Floating Point Square Root (SQF)	DCID
CD225E1.001	Decimal Data Input Converter (DATIN)	
	IBCDC	CIS
	IBCDW	DRVR
	IINT	DRVR, CIS
	IOCTAL	FILSET
	IREAD	DRVR, CIS, FILSET
CD225E1.005	General Purpose Output Routine (OUT)	DCID
CD225E2.001	Symbolic Tape Input/Output System (SIOS)	
	DIREDT	DIRED
	DIWRIT	DIWRI
	EOFOUT	DIWRI
CD225E5.001	Console Print Routine (PRINT1)	DCID

Appendix D

ERROR HALTS

Absolute Location	Relative Location	Routine	Cause
03070	PRCHK+2	PRNC	Printer out of paper
03270	DATPR1+2	PRNC	Illegal data record
03513	DATPR2+6	PRNC	Illegal data record
03642	DICIN4+2	PRNC	Illegal dictionary record
03767	DATTS1+2	PRNC	Illegal data record
04140	ALFA2+2	PRNC	Illegal dictionary or data record
04213	PHDNI+8	PHDNI	Pushdown store overflow
04253	FLTR2+2	FILTER	Process overflow
04330	CIS+8	CIS	Card number referenced that is not in sequence
04365	CISI+13	CIS	Card reader improperly loaded
04367	CISI+15	CIS	Card reader improperly loaded
04403	CISRP+8	CIS	Card numbers out of sequence
04407	CISRP+12	CIS	Card reader improperly loaded
04450	LMI+2	CIS	Negative field number
04456	LMH+6	CIS	Card has value exceeding allowable maximum
04473	REL+6	CIS	Card number referenced that is not in sequence
04563	TESTAN+6	CIS	Card number referenced that is not in sequence

Absolute Location	Relative Location	Routine	Cause
04602	REF3+2	CIS	Two "and" card numbers in a sequence are identical
04675	DIREDA+4	DIRED	Two consecutive dictionary items on input tape
05057	EQ-1	DCID	Illegal relationship number
05247	VARF1+7	RETRVL	Attempting to retrieve on comments field
05271	VARF2-1	RETRVL	Attempting to retrieve for other than or on variable field
05334	TMPWA+5	RETRVL	Attempting to retrieve for other than or on variable field
06007	DRVR+1	DRVR	Card reader improperly loaded
06011	DRVR+3	DRVR	Card reader improperly loaded
06053	RINI-1	DRVR	Invalid option requested on ID card
06146	FLST1+1	FILSET	Card reader improperly loaded
06161	FLST2+1	FILSET	Card reader improperly loaded
06174	FLST2+12	FILSET	Seventh file descriptor card for SRFT non-zero
06177	FLST2+15	FILSET	Forty-eighth file descriptor card for PRFT non-zero
06756	LOCAX-1	RETRC	Illegal correlation card (column 1)
06764	FF+3	RETRC	Illegal table number
07000	VF+4	RETRC	Illegal table number

Appendix E

PRINT NUMBERS FOR INQUIRY AND CORRELATION CARDS

Dictionary Fields

1	Dictionary class code, subclass code and chronological code
2	Dictionary serial number
5	Ingredients class code, subclass code and chronological code
6	Ingredient class code
7	Ingredient subclass code
8	Ingredient chronological code
31	Class code
32	Subclass code
33	Chronological code

Data Fields

1	Data item class code, subclass code, and chronological code
12	Data item serial number
13	Year of submission
14	Submitting activity
15	Kind of sample
16	Number of time units
17	Unit of time
18	Degrees stored at
19	Laboratory experiment number
20	Laboratory serial number
21	Gram ounce indicator
22	Weight
23	Date processed year
24	Date processed month
25	Packaging
26	Processing
27	Type of test
28	Evaluation
31	Class code
32	Subclass code
33	Chronological code
34	Packaging code
35	Packaging subclass code
36	Processing class code
37	Processing subclass code

Appendix F

FORMAT TABLE CARDS FOR CURRENT SYSTEM

```
0206200   SRFT1
0206344   SRFT2
0020200   SRFT3
0020204   SRFT4
0422400   SRFT5
0222410   SRFT6
0000000   End of SRFT
0003140   PRFT1
0005140   PRFT2
2203140   PRFT3
2204000   PRFT4
0000000   PRFT5
2202315   PRFT6
2202307   PRFT7
2202340   PRFT8
2204000   PRFT9
0000000   PRFT10
0003140   PRFT11
0005140   PRFT12
0006340   PRFT13
0006307   PRFT14
0006215   PRFT15
0010400   PRFT16
0010150   PRFT17
0010413   PRFT18
0012600   PRFT19
0012254   PRFT20
0212062   PRFT21
0015140   PRFT22
0016340   PRFT23
0016207   PRFT24
2006500   PRFT25
2010500   PRFT26
2213140   PRFT27
2413140   PRFT28
2214000   PRFT29
0000000   PRFT30
0002315   PRFT31
0002307   PRFT32
0002340   PRFT33
2006206   PRFT34
2006300   PRFT35
2010206   PRFT36
2010300   PRFT37
2213140   PRFT38
0000000   PRFT39
0000000   PRFT40
0000000   End of PRFT
```

Appendix G

COMPOSITE TABLE CODES

Packaging and Processing

1/0	64
1/6	70
1/7	71
2/1	129
2/4	132
2/13	141
2/22	150
3/4	196
3/5	197
3/6	198
3/7	199
4/1	257
4/7	263
4/10	266
5/11	321
6/0	384
7/0	448
7/2	450
7/3	451
7/4	452
8/0	512
8/1	513

Test Procedures

1/1/1	2113
1/5/2	2370
1/5/7	2375
2/1/13	4173
3/11/4	6852
3/11/6	6854
5/2/3	10371
6/1/1	12353
6/2/2	12418
6/3/1	12481
6/3/2	12482
6/3/3	12483
7/1/1	14401

Food Items and Ingredients

1/0/1	8193	8/6/21	66325
2/2/10	16650	8/7/6	66438
2/2/11	16651	8/7/22	66454
2/2/14	16654	9/2/3	73987
2/2/15	16655	9/2/14	73998
2/2/16	16656	9/3/5	74117
2/5/4	17028	9/6/13	74511
2/6/5	17157		
2/7/6	17286		
2/8/7	17415		
2/9/8	17544		
2/10/9	17675		
4/1/1	32897		
4/1/2	32898		
4/1/3	32899		
4/3/0	33152		
4/5/5	33413		
5/3/8	41352		
5/3/12	41555		
5/6/2	41730		
5/6/10	41738		
5/6/12	41740		
7/2/1	57601		
7/2/2	57602		
7/2/3	57603		
7/3/4	57732		
7/5/1	57985		
7/5/5	57989		
7/5/15	57999		
7/6/0	58102		
7/6/16	58118		
8/1/7	65671		
8/1/18	65682		
8/3/2	65922		
8/3/17	65937		
8/4/19	66[illegible]7		
8/4/20	66[illegible]		
8/4/24	66072		
8/6/6	66310		

Appendix H

DEMONSTRATION MATERIAL

Class, subclass and chronological codes for the pages of test data referred to in Section VI, and taken from the "Storage Stability Studies" handbook

Partial printout of page 14 of test data by Keydata teletype station

Partial printout of page 14 from retrieval and correlation program

Six requests made by QR&EC as the basis for demonstrating the retrieval and correlation program

TEST DATA CODES

Listed below are the class, subclass and chronological codes for the pages of test data referred to in Section VI of this report and taken from the "Storage Stability Studies" handbook. The chronological codes do not appear in Table 1 of Appendix A.

Codes	Food Item	Page
4/1/1	Candy bar and disc, chocolate, sweet enriched	14,17
4/1/2	Candy, starch jelly, disc, lemon	28
4/1/3	Candy, starch jelly, bar, cherry, lime, lemon and orange flavored pieces	31
2/5/4	Spaghetti, Group II, Class 1, Style A	39
2/6/5	Cookie, chocolate, sandwich	43
2/7/6	Cookie, sandwich, butterscotch	44,45
2/8/7	Pound cake	52
2/9/8	Fruit cake	54
2/10/9	Fruit cake bar	57
5/6/10	Dry whole milk	66
5/3/11	Cream, dry, coffee type	76
5/6/12	Milk, dried, modified, sweetened	77
9/6/13	Potatoes, white, diced, dehydrated	80
9/2/14	Beans, white, without pork, in tomato sauce	84
7/5/15	Apricots (in heavy syrup)	87
7/6/16	Fruit cocktail (in heavy syrup)	92
8/3/17	Chicken and noodles	97
8/1/18	Beef steak	98
8/4/19	Hamburgers without gravy	100
8/4/20	Hamburgers with gravy	102
8/6/21	Fried ham with juices	106

```
0-CANDY BAR: CL:4 SC:1 SCL:1

1-INGR:CHOCOLATE SWEET:  -NIF-  CL:4  SC:3  SCL:0

2-N:CANDY BAR AND DISC CHOCOLATE SWEET ENRICHED


  REC:  1
-----------------

3-KIND:0  ACTV:01   YEAR:50

4-TEMP:& 0  UNIT:F TIME:0

5-SERL:10  EXP:14  SIZE:Z 0   NO:11  YR:50


6-PACK:PARCHMENT PAPER: CL:4 SC:1
       ALUMINUM FOIL: CL:4 SC:10

7-PROC:DISC:1
)
7-PROC:DISK: CL:3 SC:4
       BAR: CL:3 SC:5

8-EVAL:HEDONIC: CL:7 SC:1 SCL:1  READ:73
       PEROXIDE PV: CL:6 SC:1 SCL:1  READ:40
       FATTY ACID FFA: CL:6 SC:2 SCL:2  READ:148
       FLORESCENCE SALINE :  -NIF-  CL:1-

8-EVAL:HEDONIC: CL:7 SC:1 SCL:1  READ:73
       PEROXIDE PV: CL:6 SC:1 SCL:1  READ:40
       FATTY ACID FFA: CL:6 SC:2 SCL:2  READ:148
       FLORESCENCE SALINE: CL:6 SC:3 SCL:1  READ:0
       THIAMINE: CL:3 SC:11 SCL:4  READ:368

9-N:BARS FIRST YEAR DISCS FOR BALANCE OF STUDY


  REC:  2
        LINE:4
--------

4-TEMP:& 100  UNIT:F TIME:3

5-SERL:10  EXP:14  SIZE:Z 0   NO:11  YR:50
```

PARTIAL PRINTOUT OF PAGE 14 OF TEST DATA BY KEYDATA TELETYPE STATION (Part 1 of 2)

```
6-PACK:PARCHMENT PAPER: CL:4 SC:1
       ALUMINUM FOIL: CL:4 SC:10

7-PROC:DISK: CL:3 SC:4
       BAR: CL:3 SC:5

8-EVAL:HEDONIC: CL:7 SC:1 SCL:1  READ:70
       PEROXIDE PV: CL:6 SC:1 SCL:1  READ:0
       FATTY ACID FFA: CL:6 SC:2 SCL:2  READ:0
       FLOURESCENCE SALINE: CL:6 SC:3 SCL:1  READ:0
       THIAMINE: CL:3 SC:11 SCL:4  READ:0

9-N:BARS STALE OR OFF FLAVOR


  REC:  3
        LINE:4
--------

4-TEMP:4 100  UNIT:F TIME:6
5-SERL:10  EXP:14  SIZE:Z 0   MO:11  S
C
TaSERL:10  EXP:14  SIZE:Z 0   MO:11  YR:50


6-PACK:PARCHMENT PAPER: CL:4 SC:1
       ALUMINUM FOIL: CL:4 SC:10

7-PROC:DISK: CL:3 SC:4
       BAR: CL:3 SC:5

8-EVAL:HEDONIC: CL:7 SC:1 SCL:1  READ:67
       PEROXIDE PV: CL:6 SC:1 SCL:1  READ:0
       FATTY ACID FFA"
F
8-EVAL:FATTY ACID FFA: CL:6 SC:2 SCL:2  READ:1-

8-EVAL:HEDONIC: CL:7 SC:1 SCL:1  READ:67
       PEROXIDE PV: CL:6 SC:1 SCL:1  READ:0
       FATTY ACID FFA: CL:6 SC:2 SCL:2  READ:0
       FLOURESCENCE SALINE: CL:6 SC:3 SCL:1  READ:0
       THIAMINE: CL:3 SC:11 SCL:4  READ:0

9-N:BARS STALE OR OFF FLAVOR


  REC:  4
        LINE:4
--------

4-TEMP:4 100  UNIT:F TIME:12

5-SERL:10  EXP:14  SIZE:Z 0   MO:11  YR:50


6-PACK:PARCHMENT PAPER: CL:4 SC:1
       ALUMINUM FOIL: CL:4 SC:10

7-PROC:DISK: CL:3 SC:4
       BAR: CL:3 SC:5

8-EVAL:HEDONIC: CL:7 SC:1 SCL:1  READ:62
       PEROXIDE PV: CL:6 SC:1 SCL:1  READ:68
       FATTY ACID FFA: CL:6 SC:2 SCL:2  READ:172
       FLOURESCENCE SALINE: CL:6 SC:3 SCL:1  READ:210
       THIAMINE: CL:3 SC:11 SCL:4  READ:342

9-N:BARS STALE OR OFF FLAVOR


  REC:  5
        LINE:0
--------

0-
```

PARTIAL PRINTOUT OF PAGE 14 OF TEST DATA BY KEYDATA TELETYPE STATION
(Part 2 of 2)

DICTIONARY-ITEM 04/01/001 SERIAL 213017

INGREDIENTS 04/03/008

TITLE CANDY BAR AND DISC CHOCOLATE SWEET ENRICHED

DATA-ITEM 04/01/001 SERIAL 213018 YR-SUB 50 ACTIVITY 01 SAMPLE 00 PROC-DATE 11/50

STORED 000 MOS TEMP +000 WEIGHT 000000 OZ LAB-SER 010 LAB-EXPT 000014

PACKAGING 04/01 04/10

PROCESSING 03/04 03/05

TEST 07/01/01 EVALUATION 000073 TEST 06/01/01 EVALUATION 000040 TEST 06/02/02 EVALUATION 000148
TEST 06/03/01 EVALUATION 000000 TEST 03/11/04 EVALUATION 000368

REMARKS BARS FIRST YEAR DICS FOR BALANCE OF STUDY

DATA-ITEM 04/01/001 SERIAL 213017 YR-SUB 50 ACTIVITY 01 SAMPLE 00 PROC-DATE 11/50

STORED 003 MOS TEMP +100 WEIGHT 000000 OZ LAB-SER 010 LAB-EXPT 000014

PACKAGING 04/01 04/10

PROCESSING 03/04 03/05

TEST 07/01/01 EVALUATION 000070 TEST 06/01/01 EVALUATION 000000 TEST 06/02/02 EVALUATION 000000
TEST 06/03/01 EVALUATION 000000 TEST 03/11/04 EVALUATION 000000

REMARKS NA

PARTIAL PRINTOUT OF PAGE 14 OF TEST DATA
FROM RETRIEVAL AND CORRELATION PROGRAM

QR&EC DEMONSTRATION REQUESTS

Listed below are the six requests made by QR&EC as the basis for demonstrating the retrieval and correlation program

1. Find the mean hedonic rating for white beans sweet sauce with and without pork and/or white beans in tomato sauce with and without pork, for all times in months and temperatures.

2. List all items packaged in foil which have been stored at 100° for not less than 18 months and not more than 24 months, inclusively.

3. List all items stored at 40°, 70° and 100° for 36 or more months.

4. List the canned dehydrated diced white potatoes stored at 70° and at 100° where the mean hedonic rating is 6.9 or greater.

5. List all items containing chocolate which were stored at 100° for 6, 12 and 18 months, and which were tested for hedonic rating and sucrose content. Correlate the hedonic mean rating with sucrose content as a function of time in storage.

6. For hamburgers both with and without gravy stored at 40° 70° and 100° for 6, 12 and 18 months, correlate the mean hedonic rating as a function of time.

Unclassified

Security Classification

DOCUMENT CONTROL DATA · R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author)

Charles W. Adams Associates, Inc.
Bedford, Mass.

2a REPORT SECURITY CLASSIFICATION

Unclassified

2b GROUP

3 REPORT TITLE

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4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report - 28 June 1963 - 2 April 1964

5 AUTHOR(S) (Last name, first name, initial)

Sherry, Murray E.

6 REPORT DATE	7a TOTAL NO OF PAGES	7b NO OF REFS
April 1966	125	

8a CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
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c	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) 66-22-FD FD-42
d	

10 AVAILABILITY/LIMITATION NOTICES

Distribution of this report is unlimited. Release to CFSTI is approved.

11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY
	Food Chemistry Branch, Food Div. U.S. Army Natick Laboratories Natick, Massachusetts

13 ABSTRACT

A coding scheme for machine storage and retrieval of storage study data on ration items has been evaluated and a revised version recommended. An experimental program for a magnetic tape GE-225 computer system has been designed and written. This program can retrieve storage study data from a data corpus previously stored on magnetic tape. It can, furthermore, perform simple correlations on pairs of details, such as storage time versus experimental data, stored in the data corpus. A second experimental program that acquires the storage study data directly from typed input onto magnetic tape has been written. The output of this program, which was developed for the Keydata Corporation PDP-4 on-line data processing system, has been made compatible with the GE-225. The programs were tested by operating them with a small data corpus of experimental information.

DD FORM 1 JAN 64 1473

Unclassified

Security Classification

KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Data storage	8		4			
Data retrieval	8		4			
Storage	9		9			
Military rations	9		9			
Coding			8			
Data			9			

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